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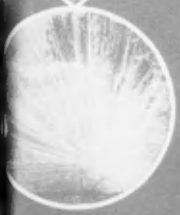

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Editorial:
Precious Elements of the Future
Inside Front Cover

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Precious Elements of the Future

➤ POWER for future generations will come from lightweights among the array of known chemical elements.

The most important elements for mankind will in the future include some that are not well-kown to the public today.

Oxygen, carbon, iron and a host of others will still be appreciated as common essentials.

But deuterium, lithium and perhaps beryllium will be the energy sources of the future. These are the elements that are presumably involved in the H-bomb or fusion reaction. There is high confidence that not too far in the distant future fusion of the elements will be harnessed to peaceful power. We know that the tremendous conversion of matter into energy that occurs in the stars has been imitated here on earth in the H-bomb. Since that has been done, the next step is to confine and to limit the reaction so that there can be fusion or thermonuclear power reactors.

These light elements are potentially more important for the future than all the world's oil, oil shale and coal. A few years ago it was felt that the future shortages of oil, uranium and even coal were the limiting factors to expanding energy uses for the future.

The abundance of the fusion elements is virtually inexhaustable. There is one part of deuterium, which is double weight hydrogen, in every 4000 to 5000 parts of hydrogen in the vast volume of the oceans of the world. It is not too difficult to extract deuterium from the sea. The oceans become the power mines of the future.

Lithium, a light metal, is also fusionable. Lithium is more abundant atomically than two-thirds of the elements.

Because of the secrecy surrounding the H-bomb or thermonuclear research, not too much can be told in detail.

We are quite sure that the beginnings of the periodic table have captured the energy future from the later part of the parade of elements.

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▶ METALLIC *lithium is seldom seen, but this photograph shows a slug or ingot of it just as it is being removed from the mold as a final step in its refining by Foote Mineral Company. The liquid metal formed is cast into iron molds coated with industrial white oil, which is also used to coat the metal for storage and transportation.*

Lithium—Metal of Tomorrow

by A. RONALD SCHILLER

▶ YOU MAY never set eyes on a silvery-white metal called lithium—not even in a museum. Unless it is immersed in oil or kept in an airtight container, even the solidest chunk soon decomposes. Yet this strange stuff looms as one of the most important metals of our time. Even now you come in contact with products containing lithium, or which lithium helped produce, every day. And when secret research now going on in the United States, Britain, Russia and elsewhere bears fruit, the element may change the course of civilization itself.

For lithium plays an important role in thermonuclear energy which, scientists tell us, could end mankind's power problems forever. It is also a vital ingredient in the new "high energy" fuels now being developed to propel intercontinental rockets and

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to shoot an earth satellite into outer space. And someday it might even make gasoline as obsolete in automobiles as the kerosene lamp now is in the home.

All of this promise has come to light very recently. For 125 years after its discovery by a Swedish scientist in 1818, lithium was considered practically useless. A leading standard textbook on industrial chemistry published only a few years ago didn't even mention it. This is not because lithium is rare; it is actually widespread in the earth's crust. Every spadeful of soil you dig in your garden contains traces of it. But the stuff has such freakish characteristics that no one knew quite what to do with it.

Third Lighest Element

Lithium is the third lightest element in the universe—only hydrogen and helium, both gases, weigh less—and it is the lightest solid in existence. The first time I was invited to pick up an ingot of the metal my muscles were braced for something so much heavier that it shot out of my hands. Drop it in gasoline and it floats. Hold a match to it and it burns with an intense white flame, and melts. A knife cuts it like cheese. Immerse it in water and it fizzes like soda. (Doctors once prescribed this bubbling "lithia water" as an antidote for gout.)

Before World War II about the only practical known use for the metal was as an ingredient in the Edison storage battery used in mine locomotives and submarines, where it helped supply a steady surge of power. Then World War II inspired new uses, and lithium production in the United States soared to meet military requirements.

Since it releases hydrogen when combined with water, packets of lithium hydride were put in air-sea rescue kits to inflate radio-antenna balloons marking the locations of downed pilots and life rafts. Other lithium compounds were used to purify the air in submarines by sucking up carbon dioxide and other noxious gases, and to de-ice airplane wings because lithium has a low freezing point and an affinity for water.

Most important was the discovery that the use of lithium hydroxide in the manufacture of lubricants enables them to perform properly in the hottest, coldest and wettest climates on earth, where other greases melt, freeze or become waterlogged. Lithium greases permitted Army tanks to operate efficiently anywhere from the Arctic to the tropics, and made it possible for pilots to zoom from the oven-like heat of a desert airdrome into the icy stratosphere without worrying about engine failure.

With the sudden curtailment of military orders after the war the infant lithium industry might have died of malnutrition, as did so many other "war babies," had it not been for lithium's enthusiasts. Firms gave away thousands of dollars worth of lithium compounds to anyone who would experiment with them. "We all became missionaries preaching a lithium gospel," one young engineer told me. By 1948, consequently, a new lithium boom had begun and today many industries use it in one form or another.

Hundreds of thousands of pounds

of lithium compounds are used in air-conditioning and refrigeration apparatus, where they absorb moisture as a sponge sucks up water. Lithium carbonate produces a low-melting free-flowing enamel that can be fired at lower temperatures in a shorter time. Most bathtubs, refrigerators and enameled equipment of all kinds today are coated with lithium enamel. Oil companies now produce a few "all-purpose" lithium greases in place of the many varieties that were once needed to keep automobiles, trucks and tractors, maritime and industrial equipment operating. Lithium has made it easier, too, to fabricate many difficult shapes in glass, such as television tubes and sealed beam headlights. It prevents the glass from cracking during heating and cooling, makes it easier to handle and shape at high speed.

In metallurgy lithium acts as a "scavenger" of gases and other impurities that form in the molten metal, thus producing a stronger, finer-grained ingot. It is widely used in welding and brazing of magnesium and aluminum, and in casting bronze and copper shapes which have become so important in industry.

Lithium compounds are employed in the production of synthetic Vitamin A and anti-histamines. In cosmetics, they keep face creams firm in hot weather, soft in cold. Lithium is also used in producing such varied items as optical lenses, phonograph records, and "screechless" chalkboards for schoolrooms. Experimentation is also going on with lithium in petroleum to act as a detergent, cleaning the engine as it lubricates. As one usually-conservative technical journal exclaimed: "There seems to be absolutely no limit to the uses of this amazing metal!"

By 1952 production of lithium chemicals had soared to three million pounds annually, which was scarcely enough to meet industry's voracious appetite. Then a serious shortage developed that year when the Atomic Energy Commission began placing large priority orders for lithium hydroxide.

The AEC's purchases posed a mystery. For since lithium is neither radioactive nor fissionable, it would seem to be of little use in atomic weapons. Business magazines and newspapers ran articles asking, "Where Is All the Lithium Going?" The AEC said nothing. A clue to the mystery finally came from Japan where scientists, after analyzing strange particles that had drifted into their atmosphere from Siberia, announced that the Russians had exploded a hydrogen device and that the particles contained sizable quantities of lithium. Scientists pointed out that the reaction of a light isotope of lithium (lithium 6) with neutrons from atomic fission creates tritium, which when fused with deuterium creates a thermonuclear explosion.

Power for Peace

If, as many experts now believe, thermonuclear power for peacetime uses can be created from deuterium and lithium, mankind will never again have to worry so much about exhaustion of its reserves of oil, natural gas and coal, or of even uranium. For, as experts agree, the reserves of lithium in the earth's crust and of deuterium in the ocean's water are practically inexhaustible. And even

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though there are still staggering problems to overcome before hydrogen power can be harnessed for peacetime use, no important scientist today believes these problems cannot be overcome eventually.

Meanwhile lithium-based high-energy fuel will probably be developed to power the nation's rockets and guided missles. The Navy's Bureau of Aeronautics has already begun construction of a 35-million-dollar plant at Muskogee, Okla., to produce these "exotic fuels," as they are called. Information about them is classified, but it is no secret that they are all based on hydrogen, an explosive gas with a gigantic kick. By locking hydrogen into a light element like lithium, a very powerful fuel can be obtained that will be not only comparatively safe to handle but very light. This is of enormous importance in rockets, which need floods of fuel to keep them going.

America's production capacity of lithium compounds has zoomed to an estimated 46 million pounds annually, and will certainly soar higher when some of the more important experimental uses are perfected. The four important producers are: American Potash & Chemical Corp., with a plant at Trona, California; American Lithium Chemicals Inc., with a plant in San Antonio, Texas; Lithium Corporation of America, with plants in Minneapolis and North Carolina; Foote Mineral Company, with plants in Virginia, North Carolina and Pennsylvania; and Maywood Chemical Works of New Jersey.

While lithium deposits occur all over the globe, North America seems blessed with a greater supply than any other continent, with known reserves strewn from North Carolina to New England and Canada. Two common types of ore are a lilac-colored rock called "lepidolite," most of which comes from Africa, and "spodumene" crystals, ranging in color from pink and pistachio to lemon-yellow and white, which are strewn through some types of granite rock like plums in a petrified pudding. Richest known deposits of spodumene are in the Kings Mountain area of North Carolina, and the provinces of Quebec and Manitoba in Canada.

The one sad note to lithium's increasing importance is that it offers little excitement for amateur prospectors who hope to make their fortunes by wandering about with Geiger counters. Lithium is neither radioactive nor easy to detect. Finding it is a job for professional geologists, involving picks and spades, muscle and sweat.

But the amateurs may be consoled by the fact that some day, after emerging from their lithium-enameled bathtubs, dusting themselves off with lithium powder and eating their breakfasts prepared in lithium-processed utensils, they will be able to zoom off in cars propelled by lithium fuel. And that their lives may be made more comfortable by abundant lithium-created electricity.

This article is published in cooperation with READER'S DIGEST.

Homes 150 miles or more downwind from major cities may be in danger from radioactive fallout following an atomic attack.

Neutrinos May Hold Part Of Universe's "Lost" Energy

Uncharged Almost Massless Particle

➤ "LOST" ENERGY of the universe may be found in neutrinos formed by stars.

Learning how much of the energy in the universe is held by neutrinos may be estimated in future experiments following confirmation of the neutrino's existence.

Discovery of the neutrino, an uncharged atomic ghost particle so small it has practically no mass, was announced in 1954.

Atomic Energy Commission scientists under the direction of Drs. Frederick Reines and Clyde Cowan Jr. this year confirmed their original discovery by further experiments conducted at the AEC's Savannah River Plant in South Carolina.

Their work culminates a long search for the elusive particle, whose existence was suggested more than 20 years ago by two Nobel Prize winners, Wolfgang Pauli and the late Enrico Fermi. Drs. Reines and Cowan used the same method in their original discovery and in the confirming studies just reported, a giant scintillation counter constructed to be extremely sensitive to reactions caused by neutrinos.

A neutrino, which is Italian for little neutral one, reacts only very weakly with matter, and could easily pass through the entire mass of the sun without change. Its existence was suggested in order to explain otherwise apparent contradictions in the law of conservation of energy in beta disintegration, important in many atomic transformations.

Although indirect evidence had long ago convinced most physicists that neutrinos actually exist, the tiny chargeless particle had previously escaped the direct detection necessary to prove its existence in the free state away from the radioactive atom from which it is emitted.

On the Back Cover

➤ LITHIUM *electrolytic cell in which the metal is produced from a mixture of lithium and other salts. The metal is being skimmed from the cell at the chemical plant of the Lithium Corporation of America, St. Louis Park, Minn.*

More than 70% of the blackstrap molasses now produced in this country could be mixed with pith from waste sugarcane stalks to produce a solid, easily transportable, high-energy feed ingredient that livestock relish.

New Drug Prevents Clots In Blood Vessels

Advances In Blood Clotting

➤ FOR PATIENTS with coronary thrombosis and others needing treatment to prevent blood from forming dangerous clots in blood vessels, a new drug to be taken by mouth plus a regulator for it has been found.

Good results with the combination were reported by Dr. Charles E. Brambel of Notre Dame, Ind., at the Boston meeting of the International Society of Hematology.

The anticlot drug is called Phenprocoumon or Marcumar. The regulator is Phytomenadione, or Konakion.

Small doses of Phenprocoumon given on two consecutive days have an anti-clotting effect lasting five to seven days, Dr. Brambel found. For long-term treatment he gives small daily doses. The sustained anti-clotting effect of this powerful drug does not lead to the dangerous condition of too-ready bleeding and hemorrhage if small doses of Phytomenadione are swallowed with it. This regulating drug does not counteract the anti-clot effect too greatly, so the danger of clots is almost missed.

Dr. Brambel has given the combination to 300 patients and studied the effect in periods ranging from one month to one year.

Hemorrhage when patients are getting anti-clotting, or anticoagulant treatment may be precipitated by stress, Dr. L. B. Jaques, L. M. Fisher and G. J. Mogenson of Saskatoon, Can., reported at the same session.

When rabbits were getting an anticoagulant, half of them died from hemorrhage when subjected to the stress of frostbite or of insulin shock or other stressful conditions.

Stress, the Canadian scientists think, may be the major factor in starting hemorrhage of patients getting anticoagulants.

Antidote for Anti-Blood Clotter

➤ DISCOVERY of a drug to reverse the anti-blood clotting effect of heparin has been made by Drs. Frederick W. Preston, Robert Hohf and Otto Trippel of Northwestern University School of Medicine.

The drug is called polybrene. It might be used, the doctors pointed out, for patients who had been getting heparin to prevent further blood clots after heart attacks or strokes and who suddenly needed an operation. Giving polybrene would promptly restore the normal clotting mechanism of the blood so there would not be hemorrhage during the operation.

Heparin is a chemical found naturally in the body that prevents blood from clotting. Sometimes the heparin mechanism is disturbed and abnormal bleeding occurs, such as in hemorrhage after birth, in leukemia, or bleeding under the skin that causes bruise-like purple patches. In such cases antiheparin agents such as polybrene are useful to neutralize the misbehaving heparin, so that the blood can clot and stop the bleeding.

Polybrene is "similar in most respects" to two other anti-heparin drugs, protamine sulfate and toluidine blue. But "polybrene is more potent than either," the doctors reported. "It is stable and may be stored for long periods of time."

Its prompt heparin-reversing action showed in studies of 33 patients at the Veterans Administration Research hospital where Dr. Preston is chief of surgical services. The studies are reported in the current Quarterly Bulletin Northwestern University Medical School.

Bleeders Make Anticlotting Stuff

➤ SOME PATIENTS with hemophilia, the hereditary bleeding disease once called the curse of the Hapsburgs, benefit from a few blood or plasma transfusions, but after the first few, these no longer make their blood clot and stop the bleeding. This happens because the patients make in their own bodies an anti-blood clotting substance.

The anticlotting substance has been thought to be an antibody to clotting material in the transfused blood, but so far it has been detected only a few times by the usual antibody testing.

Evidence that the anticlotting substance is an antibody and a method to detect it have now been found by Drs. P. Fantl and R. J. Sawers of the Baker Medical Research Institute and Alfred Hospital Clinical Research Unit, Melbourne, Australia.

Patients with hemophilia lack prothromboplastin, a substance in blood which normally starts the clotting procedure after a cut or other injury causing bleeding. These patients have inherited an abnormality of protein synthesis, so that their bodies cannot create the prothromboplastin when it is needed.

A proportion of these patients, the Australian scientists find, can make substances closely related to prothromboplastin in their antigenic property but without prothromboplastin's ability to form thromboplastin for clotting blood. These continue to benefit from blood transfusions.

A few patients, the ones with severe hemophilia, however, cannot make any prothromboplastin with antigenic property. Because of this, they are likely to develop antibodies to prothromboplastin in blood they get in transfusions. The prothromboplastin from transfused blood is such a complete foreign protein that their bodies react to it as they would to the protein of a disease germ in producing antibodies.

As a result, the transfused prothromboplastin cannot do its job of starting the clotting process, and the transfused blood, after a few transfusions, does not help the hemophilia sufferer by stopping his bleeding.

Which group a hemophilia patient belongs to can be told by a test using beta-prothromboplastin from human blood adsorbed on barium sulfate.

Anti-Clotting Affects Thrombosis?

➤ A NEW TYPE of defect in the blood clotting mechanism may play a part in coronary occlusion, or thrombosis, and in other conditions of thrombosis, it appears from studies by Drs. Henry H. Henstell and Miriam Feinstein of the Cedars of Lebanon Hospital and the University of California, Los Angeles.

The defect consists of production by the body of proteins called globu-

lins that are able to combine with and precipitate prothrombin and accessory factors from blood plasma. This results in two changes: 1. Reduction in clotting factors in the blood, causing hemorrhages; and 2. localized concentrations of prothrombin and accessory factors, causing thrombi, or clots.

Clotting defects, both hemorrhages and thromboses, are known to occur in sicknesses in which abnormalities of plasma globulins are known to exist. In other conditions, such as thrombophlebitis, coronary occlusion and the thrombosis that sometimes follows operations, the cause of the clots, or thrombi, has not been discovered in spite of many years of investigation by many scientists. The Los Angeles researchers think such cases should be reinvestigated in the light of their new theory.

New Smog-Forming Chemical

➤ TWO IMPORTANT discoveries are helping scientists in their search for a way to eliminate smog.

The two discoveries are, first, a chemical missing link in the formation of smog, and, second, the effectiveness of a recently designed smog detector nicknamed "Silent Sam."

The missing link, called compound X, is so scarce it cannot be detected in air with ordinary chemical methods. In discovering the compound, "Silent Sam" proved its ability to identify many chemicals which contaminate air at low concentrations.

"Silent Sam," a spectroscopic device described by scientists as a long-path infrared absorption cell, will be used to attack hitherto unsolvable problems. Scarce air-polluting chemicals, such as the eye-irritant in the Los Angeles atmosphere and the chemical which damages plants exposed to smog, may be ferreted out with the instrument. "Silent Sam" looks like a hot water tank lying on its side in a jungle of pipes and tubes.

Discovery of compound X bridges a gap which scientists encountered each time they approached a solution to the smog problem. Chemists had trouble finding the critical substance with conventional methods because it has a brief life under smog-formation conditions and because there is so little of it in the atmosphere.

Scientists are not certain of the exact nature of nitrogen-containing compound X, but they think it is formed in a reaction between a free radical and nitric oxide. They do know it is the agent which carries the process of smog formation along. It is the thing that gives smog its durability and permits it to accumulate.

Compound X was isolated in the laboratories of the Franklin Institute of Philadelphia. The researchers, Drs. E. R. Stephens, W. E. Scott, P. L. Hanst and R. C. Doerr, are cautious about the possibility of eliminating smog by reducing the amount of nitrogen oxides in the air even though this method is suggested by their results.

The petroleum industry has cut the loss of oil products between the well head and the consumer as much as 50% in the past 20 years.

Inadequate Dye Research Endangers Public Health

Some Food Colors Suspected

➤ THE GOVERNMENT'S research program on coal-tar dyes used to color food, drugs and cosmetics is inadequate and constitutes a danger to the public, a committee has found.

Pointing out that certain dyes certified as "harmless and suitable for use" have been found to be poisonous, the scientists urged that the research program not only be continued, but stepped up and expanded. Under present conditions it would take 25 years to test all the dyes by the latest scientific techniques.

A special committee of the National Academy of Sciences, pointed out that modern scientific research is turning up facts about coal-tar dyes that were unknown factors when the compounds were first listed in 1939 and 1940. Some have proved to be toxic to animals, others have proved to be cancer-causing in laboratory tests.

The report notes that a total of 116 dyes are certifiable under the Food, Drug and Cosmetic Act for various uses. Only 15 of the 19 certifiable for food use, for example, have been studied by the FDA to some extent since 1945. Of the 116, the report specifies, 101 have not been intensively studied.

However, they report, "it has been found that agents such as some dyes and certain crude coal-tar derivatives are capable of inducing similar types of cancer in human beings and laboratory animals. In the absence of a better guide it is usually assumed that compounds capable of producing cancer in animals are potentially dangerous to human beings.

"The demonstration that laboratory animals may develop cancer after being exposed to the action of some dyes is an important observation, and should not be ignored in evaluating the safety of the dye for human use. However, innumerable variables, including species differences, site and manner of administration of an agent, nutritional status of the test animals, action of co-carcinogens, and other factors may determine the effectiveness of an agent in inducing cancer."

The committee explains however, that although it would encourage more investigations of possible cancer-causing effects of coal-tar-dyes, "it is not of the opinion that there are large numbers of dyes on which investigations are of sufficient urgency that this work should be permitted to displace unduly other important or equally urgent research."

Coloring material from natural sources should also be tested and evaluated as to possible toxic effect on the public, the committee urged.

Approximately 500 chemical materials are being added directly to foods for various purposes.

The economic and speedy production of a rich, high-grade fertilizer from garbage is the goal of experimenters.

Draw Mental Illness Chemical Battle Plans

Tranquilizing Drugs Under Study

➤ AN ATTACK on mental disease is being made by the Veterans Administration.

Large-scale investigation of tranquilizing drugs is one part of the project.

Search for possible chemical defects in the bodies of mental patients is being made. If such are found, drugs to counteract the defects will be sought and tested.

Already a blocking agent is being sought for the chemical discovered in the body of schizophrenia patients which causes schizophrenia symptoms temporarily in normal persons.

More biochemical studies are expected to lead the way to prevention of mental disease.

At least 12 tranquilizing drugs, some not yet announced, are being subjected to careful chemical study. The drugs are not to be given to patients until VA scientists are sure of their value.

Drugs other than tranquilizers will be studied. Some mental patients are all too tranquil. Others are quieted by the new drugs but grow depressed while taking them. Stimulating drugs to use with the tranquilizers or alone will be sought and carefully studied.

One question troubling doctors now is why does reserpine, for example, depress one patient and not depress another with apparently the identical mental illness. Another vitally important question is why does chlorpromazine cause liver damage in some but not all patients.

VA will seek the answers by careful laboratory studies continuously carried on during use of new drugs. Tests for liver damage are now made almost every day instead of once a week in VA hospitals using chlorpromazine. If any signs develop in a patient, he is taken off the drug immediately. There is no waiting until yellow jaundice shows after weeks or months that the patient has suffered liver damage.

Patients in the VA studies will be followed for five or even 10 years, to see how they fare. They will be examined not only to see whether their mental health remains good, but to detect any other effects, good or bad, from the treatment.

To any who think 10 years is a long time to await results of treatment, VA psychiatrists point out that mental disease has been with us since the dawn of civilization. Looked at in that light, 10 years is a very short time.

The VA mental disease study will follow the general lines of the internationally famous study it made with the Armed Forces of the so-called wonder drugs for tuberculosis.

At first only a few hospitals will start on the studies. Gradually all 40 VA mental hospitals and perhaps some other VA facilities will be included. Reason for the slow start is the need to plan carefully for the thorough-going investigation of all phases of drug and other treatment of mental patients.

The project will be directed by an executive committee headed by Dr. S. T. Ginsberg, chief of the psychiatry division in VA central office in Washington, D.C.

Misuse of Tranquilizers

➤ AN EMPHATIC two-way warning about the new tranquilizing drugs has been issued by the American Psychiatric Association.

1. The public and doctors were warned that "casual" use of these drugs to relieve every day tension is "medically unsound and constitutes a public danger."

2. Physicians were warned to beware of "subtle pressures" from the public and pharmaceutical houses.

Normal competition among drug houses, the official statement points out, should not involve physicians in public relations enterprises directed toward premature announcement of "successful use" of particular products.

Psychiatrists are "enthusiastic" about these drugs for the treatment of psychiatric disorders, the warning statement declares. But they are "concerned" about the apparently widespread use of them by the public for the relief of common anxiety, emotional upsets, nervousness and every day tensions. In 1956, it is reported, 35,000,000 prescriptions for the drugs will be written. Of 10 compounds most frequently prescribed by doctors in 1955, three were tranquilizers.

The drugs have not been used long enough to determine the full range, duration and medical significance of their side effects, it is pointed out in the association's statement to its members.

Comprehensive research programs to evaluate the drugs, such as the one launched by the Veterans Administration, should be encouraged.

Psychiatrists are warned, however, to beware of "subtle pressures that combine to foster public misunderstanding and the misuse of the drugs."

Reinforcement of part of this warning came from Chicago. Blank placebo pills, looking just like pills of the tranquilizing drug, reserpine, had the same effect as reserpine in relieving anxiety of patients about to undergo surgical operations, Northwestern School of Medicine doctors found.

For this particular anxiety, the tranquilizing drug is not needed.

More effective than pills in relieving the patient's anxiety before operations, Drs. Roy M. Whitman, Morris A. Lipton and Eva Kavan said, is the patient's confidence in the hospital and the doctor.

Tranquilizing Drugs Differ In Brain Effect

➤ THE MECHANISM by which various tranquilizing and sedative drugs produce their effect has been studied by Drs. Bernard A. Brodie and Parkhurst A. Shore of the National Heart Institute, Bethesda, Md. and Dr. A. Pletscher, guest worker at the heart institute from Hoffmann-La Roche, Inc., Basel, Switzerland.

The good effects of reserpine come through the brain chemical serotonin, they found.

Of many tranquilizing and sedative drugs tested, only reserpine and two other alkaloid chemicals from the rauwolfia plant caused sedation and affected serotonin. The two that acted like reserpine in these ways are res-

cinnamine and deserpidine or recanescine.

The other chemicals tested included many other rauwolfia chemicals, chlorpromazine, Frenquel, morphine, barbiturate sleeping medicines, and the twilight sleep drug scopolamine.

Mental Cure Rate Up

➤ PATIENTS with chronic mental illness at the Veterans Administration at Northampton, Mass. are recovering and leaving the hospital at a 36% greater rate, thanks to the new tranquilizing drugs.

This experience is much the same as in other VA hospitals.

Among patients hospitalized five years or longer, the percentage of improved cases increased even more when these patients were treated by drugs as compared to other types of treatment.

Thirty-three were discharged among this group as compared to 19 the year before without benefit of drugs, or a 77% increase. In the less-than-five-year-group, 85 were discharged against 66 or a 69% increase.

Make Radioactive Relaxing Drug

➤ A RADIOACTIVE relaxing drug has now been created. The drug, perhaps to be known as radioreserpine, was made by growing the Rauwolfia plant in an atmosphere containing radioactive carbon dioxide.

Rauwolfia, also known as the snakeroot plant, is the source of reserpine, relaxing drug used to reduce high blood pressure and to calm mental patients. It has been used medically in India for centuries.

The radioactive reserpine, destined for tracer studies of the drug's path through the body to be made at Columbia University, New York, was produced at Argonne National Laboratory at Lemont Illinois by a research team consisting of: Edwin A. Peets and Dr. Arthur Schulert of Columbia University's Lamont Geological Observatory and Dr. John Skok and William Chorney of Argonne National Laboratory.

Oleander Sugar Drug Stops Germs

➤ A COMPOUND containing the sugary chemical of the oleander bush has turned out to be good medicine for checking staphylococci, especially when staph. germs have grown resistant to penicillin and other antibiotics.

The staph. family includes germs found in boils and a particularly dangerous kind of blood poisoning.

The new oleander bush chemical for fighting staph. germs is called oleandomycin. It was developed by Ben A. Sobin, John B. Routien and Thomas M. Lees of Chas. Pfizer & Co., Inc., research laboratories Brooklyn, N.Y., who have now received a U.S. patent for producing it by fermentation.

Atoms in Metastable State Studied in Afterglow

Excited Atoms Explain Gas Discharge

➤ CLUES to precise behavior of "excited atoms" in electrical discharge are being obtained by studies of collisions of atoms in helium being done by Dr. A. V. Phelps of the physics department of Westinghouse Research Laboratories.

Dr. Phelps noted that physicists are only beginning to gain a thorough understanding of the important processes in as simple a device as a neon sign. Electrical discharges in gases occur in lightning, fluorescent gases, sodium vapor highway lamps, and industrial objects and phenomena ranging from gas-filled tubes vital in rectifiers of alternating current for aluminum production to control circuits for communications networks.

The study of the "afterglow", the period following an electrical discharge, has contributed to knowledge of the properties of positive ions and electrons. Afterglow study in helium is convenient because it is the simplest and best understood of the gases. Furthermore, helium can be made extremely pure. In the studies he described, impurity measured less than one part in ten million.

There are three types of excited particles in the afterglow of an electrical discharge in helium. Two are in the metastable state. The metastable state is one in which atoms are unable to emit their energy in the form of light. Therefore, they are destroyed through collisions with normal helium atoms or with the walls of the tube in which the discharge takes place.

The third type is the "helium metastable diatomic molecule." One of the problems facing gaseous electronics physicists according to Dr. Phelps is that of properly identifying this molecule. Such identification is necessary to measure rates of collisions accurately. It has been learned that the presence of the metastable molecule may be detected by measuring the absorption of light by the molecule.

This method of measurement also permits investigators to follow the changes of molecular concentration with the passage of time during the afterglow.

Dr. Phelps told a New York University conference how he and a collaborator, Dr. L. S. Frost, have studied a hitherto neglected process in helium discharge: collisions between pairs of metastable atoms which result in the production of a helium ion, an electron, and a neutral helium atom.

This is regarded as a further step toward a knowledge of the rates of production and loss of ion, electron, and metastable atom particles in electrical discharges. Previously calculations of the properties of excited atoms as simple as helium had been regarded as too difficult to be worth the effort involved.

Clue To Life At High Temperature Revealed

Stable Proteins Key to Survival

➤ ORGANISMS that thrive at temperatures high enough to stop the growth of most living creatures do so because their proteins are particularly heat stable. This heat stability seems to stem from more effective hydrogen and hydrophobic bonding and decreased electrostatic repulsion between molecules.

These are the findings of Purdue University professor of bacteriology Henry Koffler and his assistant, G. E. Mallet. They studied the whip-like cell extensions known as flagella, comparing those from heat-resistant thermophiles with flagella from mesophilic bacteria which live under more temperate conditions. Flagella are made up of fibrous proteins similar to some found in blood, muscle, skin and hair.

Using urea and acetamide, agents which break hyrogen bonds, the scientists discovered that flagella from thermophiles are more resistant to these hydrogen bond breakers than those from mesophiles. Thus, a partial explanation of differences in the heat stability of these protein aggregates lies in more effective hydrogen bonding in thermophiles.

Using dodecyl sulfate, which disrupts hydrophobic bonds, the researchers achieved similar results. Flagella from thermophiles are more resistant than mesophile flagella to this anionic detergent.

Finally, they found that flagellar proteins isolated from thermophilic bacteria possess only about half the basic and acidic groups found in similar proteins from ordinary bacteria. This suggests that the heat stability of protein aggregates from thermophiles may be not only the result of more effective hydrogen and hydrophobic bonding but also of lesser electrostatic repulsion.

Test Unbalanced Diet for Disease Fighting

➤ WHILE NUTRITIONISTS now teach the importance of a balanced diet for good health, doctors may in some future time be using an unbalanced diet to fight disease.

This possibility appears from a discovery by scientists at the University of Wisconsin.

An unbalanced diet of normal nutrients, they found, will check diseased tissue in plants. Whether it will work for diseased tissue in animals, such as cancer, or for treating diseased growth remains to be learned.

The studies were made by Drs. A. J. Riker, A. C. Hildebrandt, W. H. Muir, R. W. Scott and R. H. Burris, and announced by the American Cancer Society which supports the research.

Chemicals Play Fundamental Part In Life Processes

Blood-Pressure Hormone Synthesized

THE SUCCESS of Nobelist Vincent du Vigneaud, of Cornell University Medical College, in making lysine-vasopressin means more than the addition of another synthetic hormone to medicine's arsenal of new drugs.

When Dr. du Vigneaud and his research team synthesized oxytocin in 1953 they announced a tentative structure for lysine-vasopressin as well, although efforts to make the second chemical had at that time yielded little of the active material. Lysine-vasopressin when administered to patients raises the blood pressure and acts as an antidiuretic. Oxytocin speeds uterine contractions during childbirth and releases milk in the mammary glands. Both chemicals are natural products of the posterior pituitary glands. Dr. du Vigneaud and his assistants made the first synthesis of hormone material identical to that obtained from these glands.

Production of lysine-vasopressin by three different routes, described in the Journal of the American Chemical Society, by the Cornell group shows their mastery of chemical techniques which can produce other combinations of linked amino acid structures. Such structures play a fundamental part in life processes.

Taking part with Dr. du Vigneaud in this research are M. Frederick Bartlett, Albert Johl, Roger Roeske, R. J. Stedman, F. H. C. Stewart and Darrell N. Ward, all of the Department of Biochemistry, Cornell University Medical College, New York City.

Oxytocin, the first polypeptide hormone to be made synthetically, is made up of eight amino acids, linked together into a series of ring structures in the molecule. Vasopressin has similarly been made of eight amino acids, some of them different from those in oxytocin.

Lysine, one of the amino acids built into the synthetic hormone recently announced, was found by Dr. du Vigneaud's group in the natural hormone obtained from hog glands. In glands obtained from beef, the chemists found a different amino acid, arginine, in its place. Research into the differences in products caused by such substitution of one group for a similar one is an important field in the chemistry of living matter. It is aided by general methods of combining amino acids, such as those described by the Cornell University group.

A new kind of window, made of plastic reinforced glass fibers and special ingredients that filter sunlight like a suntan oil, has been developed for storage places of materials that can be harmed by ultraviolet light.

Phenol-C 14, a radioactive compound, is available commercially in three package sizes from 1 millicurie to 0.1 millicurie, priced at $480 per millicurie.

An Anecdotal Reminiscence
By Chemical Industry Medalist

Petrochemical Survey

by J. G. Davidson, *Vice-President Union Carbide and Carbon Corporation*

(In two parts, continued in November Chemistry*)*

➤ In looking back over the past thirty-five years, I am amazed at the growth of what has come to be known as the petrochemical industry in the United States.

The growth was sudden—almost explosive. Prior to the 1920's, we had in the United States an organic chemical industry but it was small. The total sale of chemicals that we would now include in that category amounted to only 14,000,000 pounds as against 3.2 billion pounds at the present time. Furthermore, many of the chemicals, such as, acetone, acetic acid and methanol were made by processes that did not even faintly resemble the present processes. I need hardly stop to say that at that time these three products were produced by the destructive distillation of wood, the by-product and sometimes the main product being charcoal. You might say that any similarity to names, places or compounds, living or dead, was purely coincidental.

On the other hand, this situation is not so strange as it at first seems because the raw materials from which our present-day petrochemicals are produced were not then available. I am referring primarily to ethylene and propylene. It seems to me to be a fact which is totally documented in the present instance that an industry will develop with a speed that is pretty much proportional to the availability, suitability and excellence of the tools with which it has to work.

To step outside of our industry for a moment, the production of automobiles as we know it today would be impossible if it still had to rely upon the tools, jigs, fixtures and methods of the 1920's. Another illustration, this time in our own industry, has to do with the development of the aromatic division of organic chemistry, in which until the close of the First World War and for some time afterward, Germany clearly had the lead. Although the by product coking of coal and the initial use of some of the chemicals derived from this process was first developed in England by Perkins, et al., it reached its greatest development in the hands of the Germans, who needed the coke for their steel furnaces. But Germany was a relatively small and densely populated country and it was, therefore, impossible to let the smoke of the bee hive coke ovens polute the atmosphere or permit the residual liquid products to be run into the rivers as was true in certain sections of New York and Pennsylvania in this country during the early days.

The Germans, therefore, set about finding uses for these by-products, benzene, toluene, naphthalene, etc.,

and with these tools, they built a great aromatic chemical industry.

Carbide and Carbon Chemicals Corporation was chartered on October 8, 1920, as a subsidiary of Union Carbide and Carbon Corporation but prior to that date, Dr. G. O. Curme and his co-workers had carried on since 1914 a considerable amount of research work having to do with the utilization of ethylene and acetylene. The ethylene was produced by the pyrolsis of a component of natural gas, namely, ethane, and this really was the first step of the beginning of this huge petrochemical industry.

There was a great deal of ignorance at that time with respect to the actual components of natural gas. Analytical methods were extremely cumbersome, involving usually a combustion analysis. If the gas happened to be pure methane, the analysis worked out fairly well but if the gas also contained ethane and propane, the results of the analysis were largely conjecture and I can clearly remember during my college days one of the books I had occasion to refer to gave a table of the components of various natural gases and listed ethylene itself as one of the constituents, which we now know to be impossible.

We separated the ethane from the natural gas by liquefaction and distillation at very low temperatures, utilizing the Linde method as worked out by another division of the Union Carbide Corporation. Propane was isolated in the same way and these two pure compounds were then separately cracked or pyrolized to yield ethylene and propylene. With these two reactive products available now for the first time in commercial quantities and at reasonable cost, we had the tools with which to begin to build a new industry.

I might stop for a moment to pay tribute to the mechanical and metallurgical arts which began to develop simultaneously; for example, the first cracking of ethane was carried out in steel tubes. These would choke up with carbon within a very few hours and therefore become inoperative. A step forward was taken by lining the tubes with copper. These tubes would operate longer, a day or so, and then finally the Electro Metallurgical Division of Union Carbide came to the rescue with special varieties of stainless steel. This made it possible to operate the cracking furnaces for very long periods of time without coking and the following will illustrate the practical meaning of this development. I can very clearly remember our plans for the first commercial plant which we built at Charleston, West Virginia, that envisioned the use of 120 copper-lined, steel-tubed cracking furnaces but by the time the plant was actually built, ten stainless steel tubed furnaces picked up the whole load.

In looking for an outlet for the ethylene, it was natural to consult the literature and there were two products that immediately caught our attention. These were ethylene dichloride and ethylene chlorhydrin. Both of these products had been initially produced many years earlier. In fact, ethylene dichloride was one of the earliest organic chemicals. It had first been synthesized in 1795 by a group of four chemists in Holland, whose names were Delman, Bondt, van Troostwyk and Lauwerenburgh,

and it was still being referred to as the "oil of the Dutch chemists."

Ethylene chlorhydrin had been produced by Carius in the year 1863 but neither of these products had ever gotten anywhere because the tools with which to produce them—the raw material, ethylene—had never been available in commercial quantities at reasonable prices. Now, however, they were produced, first, in the pilot plant that was built at Clendenin and later at Charleston, West Virginia. Clendenin, by the way, was at that time just a little hamlet located on the Elk River, some twenty-five miles north of Charleston. Actually, it was only a wide place in the trail at that time and the road to Charleston could only be negotiated in dry weather because the road itself was merely the creek bed of the river in many places.

I came into the picture about that time. Dr. Curme and his co-workers had all moved from the Mellon Institute in Pittsburgh (where they had done their pioneering) down to Clendenin and were trying to get the little pilot plant operating. A replacement group of workers, of which I was one, grew up around the project, again back in the Mellon Institute, but since ethylene dichloride, ethylene chlorhydrin and diethyl sulphate had already been worked on, we looked in other directions. Ethylene oxide could be easily prepared from ethylene chlorhydrin and could be used in most cases in place of ethylene chlorhydrin. We found it to be a very reactive compound. Once again, we consulted the literature and discovered that ethylene oxide could be used to produce many compounds that had been prepared as laboratory curiosities many years ago; for example, the monoethyl ether of ethylene glycol had been prepared by Wurtz in 1859 although Demole in 1876 was the first to isolate and characterize it.

We now call that product "Cellosolve" and I will refer to it again in a moment. Likewise, the various ethanolamines had been prepared by Wurtz in the year 1862 and were reported in Richter's Organic Chemistry by the mellifluously sounding names of aminoethyl alcohol, iminoethyl alcohol and azoethyl alcohol. We now call them mono-, di- and triethanolamine.

In spite of the fact that we had been working for years on ethylene chlorhydrin, diethyl sulphate and the oil of the Dutch chemists, the first actual long term contract we ever signed was with the Atlas Powder Company, It was a three-year contract for the product "Cellosolve," and thereby hangs a tale.

It was during the Prohibition era that we first in a commercial way reacted ethylene oxide and ethyl alcohol to produce the monoethyl ether of ethylene glycol. We tested this for its solvent characteristics and discovered to our great joy that it was a good solvent for a great many resins, for nitro-cellulose and particularly for essential oils. This latter property was of deep significance to us because at that time the essential oil industry was being badly held up by the difficulties surrounding the procurement and use of pure ethyl alcohol. The new product filled the bill eminently well. It did not significantly alter the taste of the flavoring material and it completely obviated all the legal diffi-

culties inherent in the use of ethyl alcohol.

We christened the product Flavorol and began to prepare to set up in business. Back in those days it was not customary, as it is now, to make very thorough and complete physiological tests on new solvents before putting them on the market but, in this case, we did so test the product and found to our chagrin and surprise that not only was Flavorol a good solvent for essential oils and flavoring materials but it also was an excellent solvent for the lining of the stomach. So, we never did get into the business of selling Flavorol.

However, it will be remembered that this product also was a good solvent for cellulose nitrate so we promptly changed the name to "Cellosolve" and solicited business under that heading. This proved to be a great success and resulted in, as I have mentioned before, our first actual long-term contract. Incidentally, I might add that the Atlas Powder Company has remained a customer for "Cellosolve" during the thirty years that have since passed.

There were a number of other small occurrences connected with that first contract for "Cellosolve." Atlas was in a hurry for delivery of the product and we in turn had to buy the ethyl alcohol to make it. I remember we purchased it through the Federal Products Company, subsequently absorbed by one of the larger alcohol companies, and it came to us in 5-gallon cans all of which had to have the tops cut out by hand for there were no pouring spouts and then emptied by hand into a still that held all of two hundred gallons.

By this time, we were getting involved with the Internal Revenue Department. It will be remembered Prohibition was still in force and we needed permits to buy the alcohol and operate the processes. It became my job to contact the office in Pittsburgh and I had a very interesting but unsatisfactory interview with the agent then in charge. To force the reaction in the right direction, we used a considerable excess of alcohol. Theoretically, 7 gallons of anhydrous alcohol should combine with 44 pounds of ethylene oxide to produce 90 pounds of "Cellosolve" but we got better efficiencies by using a large excess of alcohol and recovering the unreacted ethanol by distillation.

The conversation ran something like this: I told the agent that we mixed 70 gallons of alcohol and 44 pounds of ethylene oxide which produced 90 pounds of "Cellosolve" and then we recovered 63 gallons of alcohol, to be used over again. That is all right, said the agent, but you start with 70 gallons of alcohol and you only recover 63 gallons. Where did the rest of it go to? I tried to explain that it entered into chemical combination with the ethylene oxide and to get the point you must remember this was long before the chemical industry as we know it today had been organized and the Internal Revenue agents at that time were more concerned with alcohol as a solvent for flavoring extracts, the production of rubbing alcohols and the like and little consideration was given to chemical reactions. Therefore, my explanation fell on deaf ears. The agent finally said, look, I have been listening to you now for more than half an

hour and the facts are very plain. You put 70 gallons of alcohol in this apparatus and you only get 63 gallons out. Some place along the line you lost 7 gallons that just have to be accounted for and you get no permit until you do account for them.

Well about that time I gave up and the next day I went down to see Dr. Doran in Washington. Dr. Doran, of course, was a chemist. He understood the situation immediately and we got our permit. Incidentally, I might stop here a moment and pay a little tribute to Dr. Doran, who passed away in 1942. He was, so far as I know, the first technically trained chemist to head up the alcohol division of the Internal Revenue Department and he was very helpful in the early days of the industry.

Remember, in those days there was no synthetic ethyl alcohol produced. We, ourselves, did not make it until 1929 but when that time came along, Dr. Doran was one of the first to recognize the fact that the industry would be in fetters if we had to operate under the old regulations which were set up for the fermentation industry. These regulations required that you could only operate a plant from sunrise to sunset. You could ferment so many days a week, then distill so many days a week and there could be no operations on Saturday or Sunday. The product, usually whiskey, was stored in wooden barrels, which barrels had to be stored in a certain type of brick warehouse built according to rather rigid rules and specifications. We, of course, wanted to store alcohol in big outdoor steel tanks and it was through Dr. Doran that this became possible.

Our bonded warehouse No. 132 was the first one that was not a brick building. It consisted of a number of large storage tanks, surrounded by a concrete wall, on top of which was a cyclone fence with stranded barbed wire at the top. If we had had to deal with people like the Pittsburgh agent, the development of synthetic alcohol would have been held back for years.

About this time ethylene glycol appeared on the scene. We had been producing it in small quantities for some years but could not find an outlet for it. There were three possible uses; as an ingredient in the production of non-freezing dynamite, as an anti-freeze for automobiles and as a humectant for tobacco. None of these fields developed easily or quickly. Alcohol and primarily ethyl alcohol was the automobile anti-freeze in favor, while glycerine was the product used both for dynamite and the moistening of tobacco. We managed to break into the dynamite field first because here again the companies producing dynamite were run by technical men, largely chemists, and after a series of tests, they began to buy glycol to replace not glycerine itself but what they then called D-glycerine, a polymer of glycerine which had some anti-freeze properties. Glycol, however, was much superior and was quickly adopted and it has been standard practice to use it in these operations ever since.

The automobile industry, however, gave us a few headaches and we in turn gave them a few also. Many of us in the company and in the laboratory had used glycol as an anti-freeze in our own personal automobiles without encountering any trouble for

several years. However, when we began to sell it as a commercial product, we ran into all sorts of difficulties. I well remember the man who had a brand new Cunningham automobile in Indianapolis and at that time the car, since discontinued, cost about $8000.00. He figured that if a mixture of ⅓ glycol and ⅔ water was good, pure glycol would be just three times better and that is what he put in his car. It just so happens that pure glycol has a freezing point of 8.6°F. while the eutectic mixture of water and glycol freezes near —54°F. The net result was a cracked cylinder block, an irate customer and a demand for a new automobile.

Another time I was summoned hastily to Detroit to view the catastrophe that had overcome a fleet of taxi cabs. I got out there in the morning and the manager of the company sadistically showed me the pump impellers from some 40 to 50 taxi cabs. The vanes of the pumps had been eaten away until just a carboniferous skeleton remained. While I was trying to think of some soothing and ameliorating phrases to use in this emergency, I asked to see the cans in which the anti-freeze had been purchased. Lo and behold! It was not Prestone at all but a brand of glycerine that had a trade name somewhat similar to Prestone. However, this indicated a need for an inhibitor when the anti-freeze was to be used in cars undergoing rigorous service during the winter and in a few months' time we had the answer. There have been no corrosion difficulties since, providing you don't try to use it over and over, year after year, and Prestone is now the largest selling anti-freeze in the world.

Interestingly enough, in 1925 all anti-freeze was either ethyl or methyl alcohol but as of 1954 ethylene glycol non-evaporative anti-freeze accounted for 70% of the market in spite of its higher price while the other 30% was accounted for by methanol, ethyl alcohol having practically dropped out of the race.

In working on all these new products, of course, the most important thing was to develop markets where none existed. The ethanolamines were a case in point.

We found they were good solvents for certain types of dyes and began to develop a market in that direction. We also found they were alkaline emulsifying agents, excellent constituents of floor polishes and certain types of cosmetics but at the time, which was quite a few years ago, there were a number of so-called "patent pirates" around who waited until some new product was announced and then would rush in to get a number of so-called nuiscance or use patents, their theory being to collect a royalty from either the manufacturer or the customer.

Because of this, we spent almost a year working out all the conceivable uses for the ethanolamines we could think of and then finally we published a paper in which we disclosed all the uses we had found and knew would work, the uses for which we thought they would work and many uses for which we merely suspected they might work.

Within one week after that paper was published a thoroughly reputable company came to us in high excitement. They had been looking for an absorbent for acid gases, one that

could be heated after it had absorbed the gases, thus disengaging them so they might be recovered in pure form and leaving the absorbent liquid in such condition that it could be used over and over again. The ethanolamines proved to be the answer to the maiden's prayer or at least to the company's prayer and this turned out to be the Girdler process for the absorption and recovery of acid gases, which process is very widely used throughout the United States today for the recovery and extraction of such gases as carbon dioxide and hydrogen sulfide that must be removed from a gas stream either because of their deleterious properties or because it is profitable to remove and recover them for their own value and this today is one of the largest uses of the ethanolamines.

I cite this illustration just to prove no matter how good you are there is no substitute for the millions of chemically-trained brains throughout the country that are searching all the time for new products or, conversely, have worked out a new process and only need the right kind of chemical to make it work.

This address was delivered before the American Section, Society of Chemical Industry

Medical Reactor for M.I.T.

➤ A UNIQUE ATOMIC reactor primarily designed for medical treatment and research is now under construction at Massachusetts Institute of Technology. It will be the first and only atomic tool of its kind in the country with a downward-directed beam of nuclear rays. This means that the medical and biological facilities will be centered in a therapy room, located underground directly beneath the reactor itself.

Designed to serve all medical organizations in Greater Boston, the therapy room itself will be a large and completely equipped operating room. Thus, irradiation of patients immediately after surgery will be possible.

Three types of medical treatment and research will be available to New England medical scientists when the reactor is completed. They are:

1. Neutrons or gamma rays from the reactor may be used directly to irradiate tumors in patients brought to the medical therapy room.

2. Basic studies of the effects of neutrons or gamma rays on living tissues will be possible.

3. Neutron-produced short-lived isotopes, never before available in New England, can be produced.

Grants to M.I.T. were made by the National Science Foundation, $500,000, and the Rockefeller Foundation, $250,000. The cost of the reactor will be at least $2,000,000.

An immediate use of the medical facilities will be a new treatment for cancer of the brain, developed by Dr. William H. Sweet of the Massachusetts General Hospital, Dr. Gordon Brownell also of Massachusetts General, and assistant professor of nuclear engineering at M.I.T., and Dr. Lee Farr of Brookhaven National Laboratory.

Income Affects Food Use

➤ THE WORLD is changing its eating habits.

Western Europe is consuming more fruit, milk and cheese than before the war. Bread is replacing rice in some countries of southeast Asia. America is eating less grain products and potatoes and more eggs, green vegetables, citrus fruits and tomatoes.

The change in people's eating habits can not be attributed solely to a change in their tastes and preferences, E. O. Pollock of the U.S. Department of Agriculture foreign agricultural service says.

"Historically," Mr. Pollock points out, "changes in eating habits follow one general trend. At a low income level, people eat mostly cereals, starchy roots and tubers, which are the cheapest source of calories. As their income rises, they consume fewer of these foods and eat more peas and beans, animal products, other vegetables and fruits. This has always been the case and there it little likelihood that this trend will change."

Just how fast the changes take place depend on certain forces. One of these is changed price relationships, a good example of which is the use of wheat instead of rice in India, Ceylon, Japan and the Philippines. A shortage of rice caused its price to go up, so people started to buy the cheaper wheat. Similarly in this country, margarine is now consumed at three times the amount it was before the Second World War, while butter consumption is down 50%.

Other factors that force a change in eating habits are the interplay of consumers' income and the prices charged consumers; government action, such as nutritional programs; and the growth of the population, where an increase usually brings a demand for more milk and other protein-rich foods.

All these factors affect one another. Each or all may result in a permanent change in food habits, although there could be reversals. If meat prices dropped here for instance, the American housewife might buy more meat and less fruit, milk and cheese.

Acid Added to Bread Increases Growth

➤ ADDING a small amount of the amino acid, l-lysine, to white bread almost tripled the growth rate of laboratory rats, Drs. J. B. Hutchinson, T. Moran and J. Pace of the Research Association of British Flour-Millers' Cereal Research Station at St. Albans found.

What effect the lysine enrichment of white bread may have on other aspects of development still needs to be learned, the scientists stated in their report to the scientific journal *Nature*.

Catalysis Is Basically Surface Phenomenon

Mechanism of Catalysis Studied

➤ THE mechanism of catalysis is studied at the new Parma, Ohio, laboratories of National Carbon Company, a Division of Union Carbide and Carbon Corporation.

Dr. J. A. Krumhansl, Assistant Director, explains that catalysts, which are used in making gasoline, fuel oils, ammonia, synthetic rubber, textiles and a host of other products, have been developed largely on an empirical, trial and error basis since a basic description of their behavior is exeedingly complex. The day when catalysts can be designed for specific purposes, on the basis of applied scientific theory, is a good deal closer than might have been foreseen a decade ago.

The action of these catalysts or chemical accelerators may be appreciated by the following:

Place natural protein, say, a piece of rare beefsteak, in a solution of concentrated, 20 percent hydrochloric acid. It may take days before the meat reacts and dissolves completely in the strong acid. If the acid is boiled, the same effect can be produced in a single day or so. High temperature is thus a well known way of speeding chemical reactions.

But there is another way of speeding reactions. For example, there is a chemical compound known as pepsin. Put a pinch of that in the meat-acid solution and the meat dissolves in three or four hours, without boiling or the use of high temperatures.

Pepsin is a type of catalyst, a substance which in exceedingly small amounts accelerates reactions enormously and does not change during the process. Catalysts may split or combine hundreds of thousands or even millions of molecules a minute. They make possible reactions that might otherwise proceed far too slowly for commercial use. In other cases, they permit the reactions to take place without extra high temperatures and pressures.

The need now is basic research on the mechanism of catalysis. It is essentially a surface phenomenon. In a typical reaction, molecules of ethylene and oxygen migrate in solution to nearby sites on the surface of an activated catalyst. They stick to the surface, and react together to form molecules of ethylene oxide. Then they fly off from the catalyst surface into solution, and leave the reactive sites vacant for further use. All this happens in a fraction of a second.

The first step in studying such processes, Dr. Krumhansl points out, is to concentrate on simpler surface reactions, and to slow them down. All reactions proceed more slowly at low temperatures, so National Carbon investigators will conduct some tests at liquid-helium temperatures of about 454 degrees below zero Fahrenheit. At these levels oxygen atoms, for example, will stick to surfaces, but will "stay put" and not react with other atoms. Then by raising the

➤ THE TIP *of an extremely sharp tungsten needle would look like this if it were magnified* 100,000,000 *times. The model is being used in a basic study of catalysts, the mysterious materials which speed chemical reactions—and are employed to make automobile antifreezes, synthetic rubber and textiles, and a host of other products. Since accelerated chemical reactions take place on the surfaces of catalysts, researchers at the new Parma, Ohio, laboratories of National Carbon Company, a Division of Union Carbide and Carbon Corporation, study what happens on tungsten surfaces in regions in which dimensions are measured in billionths of a billionth of a square inch. The dark marbles represent molecules of oxygen which may attach themselves to a submicroscopic site of catalyst surface.*

temperature, catalytic-type reactions will take place, in slow motion, as it were.

But researchers must be able to see signs of such reactions. The magnitude of this problem is indicated by the fact that they take place on infinitesimally small surface areas measured in billionths of a billionth square inch. To do this Parma scien-

XUM

tists will work with two new field emission electronic microscopes, instruments developed only a few years ago.

One of the instruments, an electron field emission microscope, can magnify up to 5,000,000 times and will be used to study the motions of atoms across catalytic-type surfaces and the forces required to make these particles "stick" or to remove them. The other instrument, an even more powerful "ion emission" microscope which magnifies 50,000,000 times, will be used to determine exactly what molecules or atomic complexes form on specific surface sites.

➤ "FASTER, Oscar—*this is quick-drying paint!*"

For The Home Lab

Lactose

by Burton L. Hawk

➤ From the sugar cane we obtain sucrose or "cane sugar," and from grapes and other fruits we obtain grape sugar or glucose. So it is logical that we should obtain milk sugar (lactose) from milk. In fact, lactose occurs only in milk. No other natural source is known.

Lactose is not as sweet as sucrose and is not as soluble in water. If you have ever eaten ice cream with a sandy or granular texture, you can blame it on the lactose which crystallizes out at low temperatures. To avoid this condition, many ice cream manufacturers add gelatin to their product. The gelatin provides a protective colloid which discourages the crystallization of lactose.

Lactose is prepared by removing the fat and casein from milk and evaporating the whey. Since it is only present to the extent of 3 to 5 per cent, the yield is not too great.

To obtain a better yield, we suggest you prepare a concentrated skim milk by using nonfat dry milk solids ("powdered milk") which you can get at the grocery store. Reconstitute the dry milk, using more than is recommended on the can. For example, if the directions call for 3 tablespoonfuls to one cup of water, use about 4 tablespoonfuls to one cup of water. Mix the solids with warm water, as directed on the package, and transfer the cup of concentrated skim milk to a beaker. Heat the milk slowly to about 50 degrees. Add dilute acetic acid to the warm milk, in small portions, with constant stirring. Use a 10% solution of the acid. As you stir the milk lumps of casein will separate out. Continue to add the acid as long as this precipitate forms. Between 5 and 10 cc. of the dilute acid will be required. Allow the milk to stand for 10 minutes, at which time the casein should be more or less coagulated in one lump. Carefully scoop the lump out of the solution. It should not be necessary to filter the solution.

Next, it is necessary to neutralize the clear solution. To do this, add dilute sodium hydroxide to the milk until a piece of red litmus paper immersed in the liquid *just* turns blue. Then add a few drops of dilute acetic acid until the blue paper just turns red. It is best to have the solution slightly acidic. Heat the milk to boiling and add 1.5 grams of precipitated calcium carbonate. Stir thoroughly while adding and then quickly filter the solution while it is still hot. This filtering operation may be somewhat slow, but have patience! When you finally get it, evaporate the filtrate to about 50 cc. by *gently* heating. Be careful not to overheat and scorch the product. Cool the solution and add 150 cc. of alcohol. Stir, and filter. Set the filtrate aside in a warm place for a day or two. Crystals of lactose will separate out as the solution evaporates. Filter them off, wash thoroughly with alcohol and allow them to dry.

Now, what have we done? First, by adding the acid we precipitated most of the proteins (casein, etc.) in the milk. This left the lactose along with some minerals still in solution. Calcium carbonate was added to neutralize any free acid present in order to prevent hydrolysis of the lactose. You will remember that sugars are hydrolyzed by heating with acids. In the case of lactose, this treatment will produce glucose and galactose which we do not want now. The alcohol was added to separate the lactose from any minerals that might be present. Since it is only slightly soluble in alcohol, a large volume was added. And also, for this reason, it crystallizes out of solution first.

Lactose has the same formula as cane sugar, $C_{12}H_{22}O_{11}$. but it is different in molecular construction. Unlike sucrose, lactose will reduce Fehling's or Benedict's Solution. Add a portion of one of these test solutions to a solution of lactose and heat to boiling. Note the orange-brown precipitate formed.

We have seen that the oxidation of sucrose produces oxalic acid (CHEMISTRY, Feb., 1956). When lactose is oxidized, oxalic acid is also obtained along with *mucic acid*. Suppose we attempt to prepare some of the latter.

Place 5 grams of lactose (either your own production or from the drug store) in an evaporating dish. Add 15 cc. of concentrated nitric acid and heat the mixture *gently*. As soon as the brown fumes commence to form, discontinue heating. The action will proceed quite vigorously by itself. Do not inhale the brown fumes, and provide good ventilation. Leave the mixture alone until it calms down and all evolution of gas ceases. Then add an equal volume of water. Stir, and let stand for several hours when crystals of mucic and oxalic acid separate out. Filter off the crystals.

Now, quite conveniently, oxalic acid dissolves in alcohol and mucic acid does not. This makes for an easy separation. Stir the crystals with warm alcohol. Filter and repeat the operation with the residue and filter again. This procedure should remove the oxalic acid leaving almost pure mucic acid. It might be a good idea to dissolve the mucic acid in boiling water and recrystallize.

Mucic acid forms salts just as oxalic acid does. Dissolve a small quantity of mucic acid in potassium hydroxide solution. Upon evaporation, crystals of potassium mucate are obtained.

With ammonia, ammonium mucate is obtained. Mix a small quantity (about .1 gram) of mucic acid with 2 cc. of ammonium hydroxide in an evaporating dish. Carefully heat the solution and allow it to evaporate to dryness. When ammonium mucate is heated *pyrrole* is obtained. Transfer the residue just prepared to a test tube. Suspend in the test tube a soft pine splinter which has been soaked in concentrated hydrochloric acid. Heat the tube strongly. The pine splinter will take on a carmine red coloration. This reaction represents a sensitive test for the presence of pyrrole.

As stated previously, the hydrolysis of lactose with mineral acids produces glucose and galactose. Certain bacteria ferment lactose to lactic acid (this action produces sour milk). However, lactose does not ferment to alcohol when yeast is added.

An Authoritative Survey Of The Atomic Program

The Chemist in Atomic Energy

by Dr. Willard F. Libby, Commissioner, U. S. Atomic Energy Commission

(Remarks before The California Section of The American Chemical Society)

▶ From the time the uranium ore is mined, converted to U_3O_8 or to diuranate in the mill, refined to high purity uranium trioxide, hydrofluorinated to uranium tetrafluoride and reduced to uranium metal, to be placed in a reactor or further fluorinated to uranium hexafluoride to be placed in the gaseous diffusion plant for enrichment, the chemist is busily at work on atomic energy. His work continues beyond this point, too, for the irradiated fuel elements must finally be dissolved and the fission products and plutonium and unreacted uranium all separated. It is quite a business. Taken as a whole it approaches some of our larger chemical occupations in magnitude.

Upon completion of projects now under way, or definitely planned, production by the free world should be in excess of 30,000 tons of U_3O_8 per year. Today ore production for the United States alone is at a rate of nearly 3 million tons per year and is expected to reach 5 or 6 million tons. The Atomic Energy Commission has asked industry to get into the business of making uranium tetrafluoride and/or uranium hexafluoride. Proposals for deliveries totalling 5,000 tons per year of U_3O_8 equivalent of these two salts (or on an interim basis, uranium trioxide) are desired as of October 1, 1956. To many chemists 15 tons per day may seem like a small operation, as indeed it would be for a heavy chemical. However, we are speaking here of products of very high purity—pharmaceutical standards at the very least.

Industry's response to this request has been gratifying. At the present time some 32 firms are actively interested and we anticipate as many as a dozen proposals.

Atomic Power

There are other tasks also. Irradiated thorium blankets must be processed for uranium-233 and plutonium fuel elements must be developed and their processing mastered. We understand from our knowledge gained from atomic weapons how to make plutonium metal parts, but it is not so clear what the irradiation effects, especially at high burn-ups, may amount to and it is not at all obvious that plutonium with its toxicity can be used as a fuel conveniently. A very considerable job remains for the chemist to do in the methods of manufacturing plutonium fuel elements and processing them after the irradiations are completed. All manner of alloys must be tested and various devices for the prevention of the escape of plutonium in the case of accidents incorporated. The possibility

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of utilizing plutonium in atomic power piles certainly exists. The necessity of doing so is not so obvious. Let us consider this for a moment and thereby illustrate how vital is the chemist's role in the Peaceful Uses of the atom.

The Nautilus reactor operates on highly enriched uranium and as a result makes very little plutonium. (Plutonium is manufactured by neutrons interacting with ordinary uranium-238.) However, the cost of uranium-235 is such that one cannot imagine economic power being generated indefinitely by the burning of uranium-235 alone. Some dividends must be obtained and the one normally envisaged is plutonium-239, which in itself is fissionable and therefore burnable as a fuel. Most power pile designs operate with uranium containing less than 20 percent of the isotope 235 on the average. (The power bilateral Agreements for Cooperation stipulate that the uranium-235 furnished by the U. S. Atomic Energy Commission will not exceed 20 percent in concentration except for limited amounts to be used in research and development test reactors). Something like one-half of an atom of plutonium is made for every uranium-235 atom fissioned in most power reactors likely to find wide use in the near future. So, one kilogram of uranium-235 makes 500 grams of plutonium. This yield will vary with design and it may be that some reactors will yield as much as 800 grams of plutonium per kilogram of uranium-235 burned, or as little as 200 grams. It is even possible that some reactors will produce more fissionable material than they burn. The fact is that in power piles which do not use highly enriched uranium a great deal of plutonium will be made.

Now, at the moment, the only use for plutonium known is in atomic weapons. No country has yet developed the technology for burning plutonium. It may seem that the atomic weapons business could take up the plutonium. This is the course the British Atomic Energy Authority has taken in their reactors at Calder Hall and the credit given for the plutonium produced is such that the electric power from the reactor is not too expensive. It is clear, however, that the problem of what to do with the plutonium still remains. Suppose, for example, that atomic power was segregated from weapons activities as being a Peaceful Use. Then we would have to say that plutonium generated from the reactors was not to be used for atomic weapons. What would then be its value? Obviously nearly zero, unless we knew how to burn it for power. At the moment we do not, and so the chemist's role in atomic power would become a most vital one in this case, for it is the chemist who will have to tell us how to handle the plutonium in view of its extremely poisonous characteristics.

One might envisage that the plutonium made by atomic power piles could be taken into the weapons stockpile to such an extent that one would never need to burn it for atomic power. Let us consider the numbers. Roughly speaking, a kilowatt for one year amounts to 1 gram of uranium-235 or plutonium-239 being fissioned. Therefore, for the present consumption of electric power in this country, which is about 70 mil-

lion kilowatt years, if this were all atomic power, the fission of about 70,000 kilograms of uranium-235 or plutonium-239 annually would be involved, with the production of about 30,000 kilograms of plutonium-239 as a by-product. It is completely obvious, therefore, that if atomic power is successful and it uses uranium of modest enrichment, enormous quantities of plutonium will be generated. This may well exceed the market in the weapons stockpile requirements, particularly if our hopes that the peace will continue indefinitely are justified. Therefore, the problem remains with us in either case. In order that plutonium be of any value it is necessary that the chemist learn how to solve the problems involved in using it for atomic power. So chemists should be working on how to handle plutonium as a high priority matter in the development of atomic power.

Reactors delivering atomic power must work at elevated temperatures in order that a proper thermodynamic efficiency be possible. As a result, the materials of which reactors consist must operate at such temperatures and the chemist's and chemical engineer's role in atomic power, at least in principal part, centers on the chemical reactions which occur at such elevated temperatures.

In most applications of chemistry in the modern technological world, the backlog of information available on performance at ordinary temperatures is adequate for the preliminary estimates of the important reactions which will be involved and the preliminary selection of the materials of construction and the procedures to be utilized in a project. This is not true in atomic power plants for the simple reason that there is no adequate backlog of basic chemical information at elevated temperatures. This is despite the excellent work done in recent years at Oak Ridge and other laboratories.

It is not possible to predict with any reliability the relative volatilities, thermodynamic free energies, or even the molecular formulas of the compounds which are likely to result from a given mixture of elements heated at temperatures between 500 and 1,000 degrees centigrade or above. It is true, of course, that isolated portions of this great field have been mapped. In particular, the geochemists in their studies of the reactions involved in the earth's crust have done a great deal. Also, the engineers interested in the development of jet engines as well as several other groups in industry have contributed sizeable amounts of information, but the sweep of the whole field is so great, however, that it is true that great areas exist where simply nothing is known. For example, the problems of the solubilities of metals in salts at these elevated temperatures, of the solubilities of gases in metals, and of gases in salts, the problems of the rates of chemical reactions proceeding at these temperatures, of the relative densities, the lattice structures, and other physical properties of the various phases of almost any given compound at these temperatures—nearly all of these are without any general delineations.

We urge that chemists throughout the country join in a broad program on the investigation of the chemistry of high temperature systems on an

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unclassified basis; the program to be pursued over a period of years with the thought in mind that in the not too distant future it will pay its way, by solving some of the very critical problems of atomic power. Many people have said and many people understand that atomic power will never be at its cheapest until the best chemical processing is incorporated and utilized to the fullest extent. Homogeneous or fluidized reactors of various sorts have been proposed for the very reason that they bring chemical techniques to the fore.

Research programs of this sort are relatively inexpensive in terms of the monies appropriated for the various reactor projects. The entire program for the support of fundamental physical research, both chemistry and physics, of the Atomic Energy Commission is less than $50 million per year. This, as you know, is not a large amount of money in terms of the amount spent on power reactors and the development of atomic power of every kind. We can anticipate, therefore, finding such a program economical and worth while.

Another problem in atomic power is the question of corrosion in the various atomic power reactors being designed, built and considered. It is an interesting game that is being played. On the one hand a group of metallurgists, who of course are very akin to chemists in training and thought and conditioning, are asked to make a completely non-corrodible fuel element; and on the other hand a group of process chemists are asked to dissolve this non-corrodible fuel element and process it for a minimum cost. This conflict seems to force the use of new degrees of freedom such as are involved in high temperature processing, special dissolution methods, and the use of alloys with specific coolants which are inert to the dissolving reagent. It really puts the chemist to test and it is to his credit that he has made the progress that has been made to date. Nevertheless, it is obvious that this kind of conflict is somewhat unnatural and to be avoided if possible. There is one way to avoid it that is obvious, and that is to use the homogeneous reactor principle. Avoid heterogeneous fuel elements and the problem of their manufacture and dissolution and in this way one avoids the wasteful conflict considered above.

The homogeneous reactor is, of course, a family of reactors and may include anything in the way of fluidized or dissolved liquid fuels with fixed or moving moderators and with or without continuous processing of the fluid fuel as it circulates through the reactor. There are many possible variations of the homogeneous reactor, and the Commission is investigating the more promising of these. But, speaking broadly, the homogeneous reactor is the chemist's reactor, and it will be the chemist who makes it work. It is my opinion that a type of homogeneous reactor will give the cheapest atomic power in the end. We are at the point now where most of the reactors being built in Britain, Russia and the United States are heterogeneous. There seems to be a natural development in this direction, and even though the homogeneous appears to have the best chance, the fact remains that it is difficult to proceed with it until some

of the chemical problems involved in specific designs have been solved.

Finally, of all the chemical problems associated with Atomic Power perhaps the most immediate and pressing is the cheap processing of irradiated fuel elements from many types of heterogeneous reactors now under construction. For immediacy and quick bearing on the cost of Atomic Power it outranks the other atomic power jobs the chemist has to do. We have in a certain definite sense committed ourselves to a program which assumes that this job will be well done. I am certain that this will prove to have been sound planning, but there nevertheless is a very real need to interest the chemical fraternity in this task in order that it will be done.

Although the solution of these difficult problems is only a matter of time, the method of solving them quickly is to encourage good men to work at them, and now the principal difficulty appears. There is such a shortage, relatively speaking, of the highly skilled and gifted chemists and engineers who are needed to solve such problems as the corrosion of particular types of homogeneous reactors that the solution of these problems is being seriously delayed because not enough gifted people are available to work on them. The Atomic Energy Commission hopes that the Atomic Power Program can move forward with all possible speed short of interfering with the armament of our country. It is our wish, therefore, that the chemical industry interest itself in the problems of Atomic Power, for most of the chemists not now working on atomic energy are in the employ of industry. Of course, a great deal can be done by closer liaison with the universities surrounding the various reactor development laboratories such as the Argonne National Laboratory. The chemists teaching and doing research at these universities can undoubtedly contribute in the solution to the reactor development problems if the problems can be explained to them and their interest excited. These are the two sources of chemical manpower that have not yet been tapped for atomic power—the chemical industry and the university faculties. We want both. . . . We understand well the reasons why it has not happened in the past, but the understanding does not lead to a feeling of happiness that it has occurred. Considering the shortage of highly skilled technical manpower, it might even be considered a mistake to divert chemists to any great degree from the important work they do in the chemical industry now. However, it seems clear to me that we should be able to have the new miracle drugs, the new synthetics, etc. and have atomic power also. Let us try to do this. Let us try and have everything. Let us try and lead the world in the development of the Peaceful Uses of the atom without hampering our other technological developments. Let us try this. It can be done if we all try.

The chemists have to learn about atomic energy in order to have this happen, and I am most happy to have the opportunity to speak to you this evening and contribute in some small way to the effort to interest the chemical fraternity in the problems of the development of atomic power.

We need your interest greatly, because we need your skills and ability to solve the problems which have thwarted our chances in certain critical areas, particularly in homogeneous reactors and the utilization of the product plutonium.

Isotopes

We have a peaceful use already in being which next to the first of the Peaceful Uses, peace itself, is rewarding us bountifully for our investment and interest in atomic energy. This use is Isotopes. Isotopes is the utilization of radioactive elements to label compounds and materials so as to understand the mechanism of chemical reactions, the numbers of masses of materials, and for various analytical purposes by the dilution technique. Thousands of applications have now been made to research in the physical and biological sciences, but tonight I speak more particularly of the application to industrial processing. Dr. Donald E. Hull of the California Research Corporation was in many respects a pioneer in the application of isotopes to the testing of lubricants and fuels for the Standard Oil Company of California. He also developed the usefulness of radioactive tracers for plugs of liquid fuel pipelines so that their diversion at a particular valve point could be done more accurately at very considerable savings of valuable crude and other materials. In addition, a method of measuring the circulation rate for a fluidized catalyst bed was developed by him and his associates. There are several people like Dr. Hull in this country developing these uses and daily new ones appear. We estimate that during the present year over 100 and possibly 200 million dollars were saved in industrial processing costs by the use of isotopes for control methods. It seems very likely that within five years this will exceed one billion dollars. There was an article the other day by M. E. Marchant (Nucleonics, Vol. 14, No. 5, May, 1956) in which it was claimed that the use of isotopes may well save 10 percent of the total machining costs in the United States. This exceeds one billion dollars per year in itself if it should prove to be true. We can see how the further development of the use of isotopes in industry will make these preliminary figures small.

It is nearly true that every material of nature, everything we know, everything with which we deal in everyday life, can be made radioactive in a safe but easily measurable manner. This is the concept of Everyday Use of Isotopes in "exempt quantities," useful but harmless amounts. Perhaps this in itself may prove to be just as important a Peaceful Use as Atomic Power. In any case, there is no conflict between Isotopes and Atomic Power except possibly in the interests of the people developing it. However, they are so far different it seems not unlikely that the people interested in the development of Peaceful Uses for Isotopes may not be the ones who would otherwise develop Atomic Power—or it may be that the development of the Peaceful Uses of Isotopes may supplement and interest people in atomic energy in general and so get them to look at Atomic Power. In any case, the conflict seems not to be very serious. But the Everday Use of Isotopes in the control of industrial processes is a

blessing to us and the world as a whole which the atom has brought and from which we will probably receive good dividends in our entire atomic investment in the Atomic Energy Commission program.

In addition, we have the benefits of the use of Isotopes in agriculture and in basic fundamental science and, as we all know, the discovery of the new laws of nature is one of the most lucrative and profitable occupations any man can undertake, provided he is patient and far sighted enough to await the natural developments of the new knowledge.

Our children and grandchildren shall without doubt praise us for the development of atomic energy for its Peaceful Uses. With no doubt there will be new uses made of which we have not dreamed, but among the important Peaceful Uses throughout all time will be Isotopes. The chemist remains the principal applier of Isotopes, the inventor of new uses, and the principal developer of ramifications as yet not named. We can imagine the chemists will continue to play this role, so once again I say, your role in atomic energy is of extreme importance. Please think when you do your everyday work how you could do it better with Isotopes. All the materials with which you work can be made radioactive.

It is possible to measure in a reliable, easy manner the total number of radioactive atoms in a given sample of matter. Thus reagents which have a given specific activity, say of radioactive chlorine, can be measured out by volume into a solution of unknown chloride content, silver nitrate added, and a precipitate produced and the absolute concentration of radiochlorine in the resultant precipitate determined. The dilution caused by the unknown amount of chloride gives an immediate analysis for chloride in the solution. True these measurements to date are only accurate to about 5 percent, but they are so fast and so simple that I think one can say that for the chemical isotopes; hydrogen, carbon, sulfur, phosphorus, chlorine, calcium, etc., we have a technique which may liberate us from many of the difficulties in the laboratory. We should by all means introduce these techniques into the chemistry courses in the universities and high schools so the students will have this additional peephole to look into nature and see how she works. It is not that we want to teach radiochemistry particularly, but through use of these techniques the students will be taught ordinary chemistry better and will develop, I hope, an incidental interest in atomic energy and the peaceful uses of the atom.

Of the Federal funds for research and development which now constitute a major portion of the national research and development effort, only seven percent now goes for basic science.

Hard nickel plate is giving longer life to aluminum and hollow steel propellers on military and commercial aircraft.

Some types of nuclear radiations crumble organic materials such as rubber and make gums of high-quality lubricants.

One Inert Gas Substitutes for Another In Making Titanium

Argon for Helium

➤ PLENTIFUL ARGON can be substituted satisfactorily for scarcer helium in certain steps in producing the new metal titanium, the Bureau of Mines has found in a series of tests with the two nonflammable gases.

Wider use of argon would extend the Nation's supply of helium and thus strengthen the national position regarding this material.

Helium is extracted from some natural gases of the Southwest by the Bureau of Mines and large amounts are used by the Atomic Energy Commission, the Department of Defense, and private industry. Argon, extracted from the atmosphere, is employed extensively for shielded-arc welding of certain metals, but cannot be substituted for helium in all fields.

Comparable tests with the two inert gases in the Bureau-perfected Kroll magnesium-reduction process for making titanium were conducted over a period of months at the Electrometallurgical Experiment Station, Boulder City, Nev. A technical publication describing the work has been written by C. T. Baroch, Bureau metallurgist now in Washington, D. C., and two former associates, T. B. Kaczmarek and John F. Lenc.

The test runs showed conclusively that high-purity argon could be substituted for helium in the reduction of titanium tetrachloride with magnesium. This could be accomplished with no noticeable impairment in the quality of the resulting titanium sponge metal and with only minor alteration in the reduction technique. Many of the operating factors were virtually the same for both argon and helium.

Relative costs of using the gases were not determined, but Bureau Director Marling J. Ankeny said the finding are extremely significant and will be increasingly important should a crisis force the diversion of greater amounts of helium to military or atomic energy uses. He added that the Government always has advocated the use of substitute gases when they will perform a job equally as well as helium.

Plastic Film Saves Water

➤ LININGS OF PLASTIC films are being tried to prevent loss of water by seepage from farm reservoirs and irrigation ditches.

Experiments by the U.S. Department of Agriculture's Agricultural Research Service and the Utah Experiment Station show that both vinyl and polyethylene (PE) when used as film for lining reservoirs and canals will reduce the loss of water, which usually amounts to a third of all water used for irrigation purposes.

Here is Standard Couple
As Viewed by Nutritionists

"Reference Man" for Calories

➤ A "REFERENCE MAN" and a "reference woman" have been created by Food and Agriculture Organization scientists at Rome. Creation of this hypothetical couple is intended to help nutritionists in countries throughout the world estimate calorie needs for flesh and blood men and women.

The man is 25 years old, free from disease and physically fit for active work. He weighs 143 pounds, lives in a mean annual temperature of 50 degrees Fahrenheit, consumes an adequate, well-balanced diet and neither gains or loses weight.

He works an eight-hour day at a job which while not sedentary does not involve more than occasional periods of hard physical labor. When not at work, he is sedentary for about four hours and may walk for up to one and one-half hours. He spends about an hour and a half at active recreation and "household work." His food needs on an average for the entire year are assumed to be 3,200 calories daily.

His female counterpart is also 25 years old. She weighs 121 pounds, lives in the same environment and may be engaged in general household activities or light industry. Her daily activities include walking about three miles a day and one hour of active recreation such as gardening, playing with children or non-strenuous sport. Her average daily food consumption over a year is assumed to be about 2,300 calories.

If she is nursing a baby, she may need an extra 800 to 1,000 calories per day for six months. Increased calorie requirements when expecting a baby are estimated at 40,000 per pregnancy.

This is the second reference man and woman created by FAO. The first were created in 1950. Since then new knowledge has required revision of the figures.

The studies deal with calorie requirements, not with desirable composition of diets. A diet may meet the calorie requirements without being satisfactory for good health and nutrition. FAO also points out that race of itself does not influence calorie requirements. On this its report states: "As far as present knowledge goes, individuals of the same size living in the same environment and having the same mode of living will have the same calorie requirements whatever their race."

Six bottles of air from the borderlines of outer space were collected 75 miles up by steel bottles inside the nose cones of two 20-foot Navy Aerobee rockets.

The world's strongest metal has recently been produced in the form of tiny "whiskers" of perfect iron crystals.

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Excerpts from An Evaluation of Future Opportunities

Careers in Science

by Dr. Thomas H. Johnson,
Director, Division of Research, U.S. Atomic Energy Commission
(Talking to a youthful audience at Cornell College, Iowa)

➤ The present forecast about atomic power for generating electricity is that in 20 years the atomic power industry will afford at least as many jobs as all of the present activities in the atomic energy field, including the development and production of atomic weapons. That means that about 30,000 people, not now engaged, will then be employed in atomic energy. A large percentage of those must be highly trained as scientists or engineers. Without such people there would be no jobs in this field for anyone.

Nuclear reactors are already in use to generate electricity and to propel ships, but none of these now in existence is as efficient as it might be, and they have never been built in large numbers. In fact I think I can say that no reactor has ever been built exactly like another one. In the present state of their development, ways are always found for improvement.

Moreover some of the reactor types which now seem to offer the best possibilities for producing electricity cheaply have never been built because some comparatively minor technical problem has not yet been solved. These problems usually involve physics, chemistry, metallurgy, mechanical design, the flow of fluids, or the flow of heat. These problems will be with us for a long time and that is one reason why we need more scientists. In solving these problems it is not just a matter of looking up facts in the books and applying them to the particular situation.

More often than not the basic facts are not known. The chemical properties of the materials may never have been studied in the laboratory, an unexplored range of temperature may be involved, or the effects of radiation may be an unknown factor in the process. Often the particular requirements of the reactor concept cannot be satisfied by any of the available metals or alloys, so that new ones have to be made and tried. In these applications we may be looking for good nuclear properties as well as the least corrosion, the best ductility or the greatest resistance to the damaging effect of radiation.

The automobile was invented more than 50 years ago, but each year automobiles are improved by the use of a better alloy or a better designed component. In the same way nuclear reactors will continue to be improved and gradually the best type for each application will be found, but it will take many scientists and many engineers working for many years. In this work there will be important jobs for those who are trained in chemistry, in electrical, and in chemical engineering. These jobs will not only pay good

salaries but they will also reward those who do them with the satisfaction which comes from contributing to useful knowledge and helping people live better.

Another field of great importance in the immediate future is mathematics and automatic computation. We have been accustomed to think of mathematics as a universal tool of science rather than as something to make a career of, but the invention of electronic computers has changed all of that. It is now possible for a trained mathematician with the use of a computer to work so much faster and so much more effectively than his predecessors that most scientific and engineering computations, once they are formulated, will now be turned over to the mathematician to carry through.

As long as computing was done in the head or with the use of desk machines, or slide rules, everyone could do his own work nearly as well as he could get it done by the most skilled computer. Now, however, millions of additions and thousands of multiplications can be done in one second if an electronic computer is used. This means that involved problems of engineering, of banking, of scheduling, or in the fields of pure science will be solved by computation rather than by experimentation. Even problems formerly regarded as insoluble can now be solved.

In a few years every large laboratory or industrial concern will have a department of mathematics to solve its problems as they arise throughout the organization. There will also be regional computing centers fully equipped with computing machines of all descriptions each having a large staff of mathematicians who will know how best to solve the problems that come to it. Eventually these computing centers will be connected with various laboratories and shops by a network of teletypers which will feed in the data and turn out the answers. The whole operation will take a lot of inventive people, well trained in mathematics and electronics, to install, service and improve the equipment and to supervise the operators. Gradually new ideas will be injected that will revise the system and increase its usefulness.

Eventually these installations may accurately predict the weather, predict the effect on public opinion of any political event, and forecast markets. At the present time we are very short of trained mathematicians and electronic engineers to operate the computing machines in existence. We are also short of computing machines to accommodate those who would use them. I understand that 150 high-speed electronic computers are now on order in the United States. Some of these cost as much as $3 million each and a million dollars a year to operate, but they pay for themselves many times over in what they can accomplish. You can be sure of an important job if you train yourself in mathematics and computation.

Another field to consider is high energy physics, and this will appeal to those who like the fun of discovering new insight into the most basic facts of nature. I do not know how else to make this field sound attractive.

It was once necessary for a fundamental scientist to have an inheritance or some job which paid him a living wage without demanding much of his time. Without worrying about his livelihood he could then indulge in the pleasures of a telescope, or a laboratory and find out how the laws of nature operate. In modern times we have found that knowledge of the laws of nature is useful in many ways, though sometimes they cannot be foreseen in advance. Basic knowledge is now recognized as a national asset and we talk about stockpiling it for defense and for the use of our citizens and to help the world. Many scientists are now being supported by the government, and are given access to expensive and elaborate equipment while they explore the darker recesses of nature. One of the recesses most difficult to explore is the field of high energy physics.

I will start by telling you what I am sure you already know that all material things are made of atoms of which there are 101 different kinds corresponding to the 101 chemical elements: hydrogen, helium, iron, sulphur, uranium, et cetera. Each atom contains a positive nucleus surrounded by a cloud of negative electrons, the number of which equals the positive charges on the nucleus and determines how the atom behaves chemically.

The nucleus is composed of various numbers of particles of two kinds, neutrons and protons. Both have about the same mass; the proton carries a positive electrical charge; the neutron has no charge; and there are strong forces of attraction acting between all of these particles when they are very close together. These forces hold the particles together in a nucleus like grapes in a cluster. They contain many different combinations of neutrons and protons ranging all the way from a single proton in a hydrogen nucleus, a proton and a neutron in the heavy hydrogen nucleus, two protons and two neutrons in the helium nucleus, to 156 neutrons and 101 protons in the nucleus of the heaviest, of the chemical element mendelevium.

Each nucleus is a complicated system of particles and forces. It can be knocked apart, combined with other nuclei, or put into a state of internal vibration when it is hit by a high energy particle such as a proton. Mercury can be made of gold, or helium can be made of hydrogen. To accomplish these feats of alchemy one must have an accelerator which will impart a high energy to a proton. An accelerator for this purpose must generate an electrical potential of several million volts. Such machines have been in use since about 1930 and they go by the name of cyclotron, Van de Graaf accelerator, Cockcroft-Walton accelerator, betatron or synchrotron. If you are an adult and want to know how they work, just ask your young son. Just after the World War II the synchrocyclotron was invented which made it possible to accelerate nuclear particles to several hundred million volts. Then huge synchrotrons were built for energies measured in the billions of volts. The cosmotron at Brookhaven gives 3 billion volts, the bevatron at Berkeley, California gives 6 billion volts, the Russians have one nearly completed which will give ten million volts and others are under

construction at Brookhaven and in Europe for 25 to 35 billion volts.

When the atoms in a target are bombarded by such high energy nuclear projectiles many complicated things happen which are not yet fully understood nor are they likely to be understood before some of you can join the team of scientists who are investigating them. In addition to changing one element into another, frequently new particles called mesons are produced. These occur in great variety and they have complicated properties. For example, all mesons are unstable and in times varying from a millionth of a second to a millionth of a millionth of a second they are transformed into some less massive particles which dart away at a high energy. These new particles must have something to do with the force between neutrons and protons and before we can really get to the bottom of atomic energy we will have to experiment and theorize with the mesons. The knowledge may not have any immediate practical application but God put the mesons there and he gave man the curiosity to study them, so the search for an understanding of their significance in the scheme of natural law must go on.

One of the most interesting of the new particles is antiproton. I remember when I was in high school I thought that all of the scientific discoveries had been made many years ago by old men long since dead. It never occurred to me then that there was any possibility of a career in science, or that there were any active scientists still alive. How times have changed! and instead of running out of things to discover we now see that each new discovery simply enlarges the frontier from which new salients into the unknown can be launched. The discovery of the antiproton is such an expansion of the frontier of science, and its discovery suggests a host of new things to be tried and a host of new questions to be resolved and understood.

Ever since Einstein annunciated the law of the equivalence of mass and energy, $E = mc^2$, in 1913, physicists have speculated about antimatter which would combine with ordinary matter in such a way that mass would disappear and energy would come into being in the proportion predicted by Einstein. At last in the bevatron at Berkeley, matter and antimatter, protons and antiprotons, have been created out of energy and the antiprotons which carry a negative charge have interacted with positive protons in ordinary matter. Simultaneously both particles have disappeared and energy has reappeared. Only time will tell what new insight or what new applications will be the consequence of this great discovery, but it is clear that many scientists will spend many years before we will know the full meaning of the antiproton. This is a field into which those who like the most fundamental problems will be strongly attracted.

I now have time for just one more field of science, and this one may offer the greatest opportunities of all. Perhaps you have already read in the papers that the Atomic Energy Commission is exploring the possibility of harnessing the energy of the H-bomb for the peaceful uses of man. But do you know what that means? If

we can learn how to do it we would tap an inexhaustible source of cheap fuel and we would have no more concern over the future sources of electrical energy. We would get our fuel from the sea, and there is enough of it there to last for millions of years.

In our modern way of living we depend a great deal upon energy. Some of this comes from falling water but the amount available from that source is nearly all harnessed. Most of our energy comes from burning coal, oil, and gas. Some parts of the world have very little of these fuels, and even in our country the supply would run out in another hundred years or so if we keep on using them at the present rate. That is why atomic energy is so necessary. But even atomic energy in the form in which it has been developed will not provide a permanent answer to the world's fuel needs. It depends upon uranium and we don't know that economic reserves of uranium ore will supply atomic fuel requirements for more than a few hundred years. If no other source of energy can be found the populations of the world would have to diminish to the level that could be supported in the primitive way our ancestors used to live two or three hundred years ago. Our most hopeful source of energy for the long range future is nuclear fusion of deuterium, or heavy hydrogen, a material that is found in all water with a concentration of one part in seven thousand parts of ordinary light hydrogen. That may seem like a low concentration but the energy we could get by burning seawater in a nuclear fire would be two hundred times more than we could get by burning the same volume of gasoline. Of course the deuterium would have to be separated out and a special furnace would be needed. Then there will be problems of converting the energy to electricity. These appear to us now to be very difficult technical problems, but not impossibly difficult. It may take many years to develop power plants of this type but I have no doubt that we will eventually be successful. Already this field of scientific endeavor is engaging hundreds of scientists and engineers and there will be much here for the next generation to do, but to be effective it will be necessary to have good training in mathematics, physics and chemistry.

I have been able to discuss only four scientific fields which hold great opportunities for the future. But all branches of science have broadening horizons. I recommend that you give your serious consideration to a scientific or an engineering career. Such a career can be great fun, it can give you the satisfaction of having added to the store of eternally useful knowledge, it can be a patriotic service to your country, and it can contribute significantly to the betterment of the conditions of human living everywhere. But even more than these, a career in science puts a person in close understanding with nature and engenders a deep sense of reverence and admiration of God's handiwork.

If you are to have a scientific career you must prepare for it, and you must do so intensively. You must not delay nor be desultory in your studies. This is the time of life when you learn easily and it will not always be

so. You must learn to comprehend in its generality all accumulated knowledge in your chosen field. You will find that this knowledge has been codified and generalized so that it is not impossible. It will be better to go slowly and thoroughly. Above all, remember that scientific study can be fun and it should be undertaken in that spirit. It is only your enjoyment of science that can give you the stamina you will need to see you through.

More Automation Will Step Up Oil Production

➤ More oil can be produced at lower cost if refineries will use more automatic, or feedback, control principles, Albert F. Sperry of Panellit, Inc., Skokie, Ill., told the American Petroleum Institute's division of refining.

Feedback control is operation of machines by a device which can receive information from the machines and "know" when to change its operating procedure. A good example is the thermostat on your furnace, which "knows" when to turn the furnace on and off.

Although petroleum production is more highly automatized today than any other industry, very little feedback exists in most refineries except at the lowest levels of operation.

The biggest barrier to effective feedback control at the operator, technical staff and management levels is the time needed to process large amounts of data for effective feedback use. This can be overcome, Mr. Sperry said, by increased use of computers and improved data processing techniques.

Mr. Sperry called feedback control a more sophisticated aspect of automation than the complete mechanization which the term usually implies.

TV Device Takes Pictures of Live Cells

➤ Clearer, more detailed pictures of living cells in ultraviolet light can now be taken with a new device reported in the scientific journal, *Nature*.

It is called a flying-spot ultraviolet television microscope and was developed by Drs. P. O'B. Montgomery, F. Roberts and W. Bonner of the University of Texas's Southwestern Medical School, Dallas, Tex.

Its advantages, they state, are immediate visual presentation of the image and a great reduction in the amount of ultraviolet light needed to produce the image.

The TV-microscope they developed uses new deep ultraviolet scanning television-like tubes and ultraviolet photomultipliers, devices that amplify light. The picture is photographed by exposing a photographic plate to several successive frames displayed on the tube.

Grants for the research leading to development of the device came from citizens of Dallas, the Damon Runyon Memorial Fund, the Rockefeller Foundation and the Texas Instruments-Geophysical Service, Inc., Foundation.

Anyone Can Take Pictures Of Snow Crystals — Next Winter

Snow Flake Camera

➤ A JAPANESE scientist, Dr. Keiji Higuchi of Hokkaido University, has devised an instrument so simple and convenient to use anyone can take pictures of snow crystals — next winter, that is.

It consists of a portable dark box containing a holder for photographic paper and a small flashlight bulb, set about two feet apart. Several three-by-four-inch glass plates are prepared by treating the surface of each with silicone oil to repel water.

The apparatus and glass plates are cooled to outdoor temperature. After being exposed briefly to falling snow, a glass plate is put into the dark box directly on the film holder.

By opening the film holder and shining the light from above for a few seconds, shadows of the crystals are produced on the photographic paper.

The image produced is nearly full size and very clearly shows the crystal's outline, Dr. Higuchi reported to the American Meteorological Society.

For anyone who wants his own shadow photograph of a snow-drop, come next winter, that completes the outdoor procedure.

However, because Dr. Higuchi developed the new method to study the form, size and mass characteristics of snow at intervals of several minutes during a snowfall, he next warms the glass plate slowly. The individual snow crystals melt into hemispherical droplets.

The plate is again placed in the dark box and a shadow photograph taken by the same method. From the image's diameter, Dr. Higuchi can calculate the volume of each droplet.

He conducted his experiments in an igloo halfway up Mt. Tokachi and Mt. Taisetsu on Hokkaido, and obtained about 100 sets of records of the shapes and sizes of snow crystals.

Two kinds of snowflakes were found in the same snowfall, one made of crystals nearly the same size, the other containing crystals of various sizes. Studying combined crystals of two sizes, Dr. Higuchi noted, is important for investigating how snow crystals clump together, thus shedding light on the mechanism of precipitation.

The number of snow crystals in a snowflake about an inch and a half in diameter has been estimated to be about 4,000.

Chemobiotics is a term coined to describe chemicals derived principally from animal raw materials which show great promise as growth stimulants.

One of the most urgent reasons for carrying out malaria eradication with the least possible delay is the growing resistance of the mosquito carriers of malaria to insecticides like DDT.

Recent Chemical Patents

Copies of patents may be ordered from the U. S. Commissioner of Patents, Washington 25, D.C., at twenty-five cents each. Order by number and enclose remittance in coin, money order or Patent Office coupons, but not stamps.

Desulfurizing Steel

➤ A PROCESS for rapidly desulfurizing steel by the use of slags that have been premelted, solidified and pulverized has been invented by Rene Perrin and Jean Lamberton of Paris, France.

The use of such slag in the form of solid particles, added to the steel while it is being poured into a ladle, eliminates the need for a slag melting furnace in the steel making shop. To be effective, the inventor says, the slag must have a low melting point and a very high desulfurizing power. Just such a slag can be produced from fluorspar and lime.

Our desulfurizing process, claim the French invenors, functions practically instantanously in that the reaction is complete immediately following the completion of pouring. They were granted patent No. 2,750,280 and assigned the patent rights to Societe d'Electro-Chimie d'Electro-Metallurgie et des Acieries Electriques d'Ugine, Paris, France.

Makes Radioactive Water Safe

➤ RADIOACTIVE poisoning of the nation's water supplies is both a peacetime and a wartime peril. To minimize this danger, two scientists have invented an apparatus for decontaminating radioactive water to make it safe for drinking.

The decontaminator, invented by Ardath H. Emmons of Ann Arbor, Mich., and Robert A. Lauderdale Jr. of Cambridge, Mass., is compact and simple enough for use in emergencies where needed.

It removes fission products or other radioisotopes from radioactively contaminated water by having the water pass through steel wool, clay, activated charcoal, and a mixed anion exchange resin and cation exchange resin, such as "Amberlite MB-3."

In this manner, unsafe water is made potable enough to be used without fear of radioactive poisoning. In describing their invention, the scientists point out that waste solutions produced in various chemical processes in peacetime and the possible explosion of an atomic bomb in wartime, could greatly affect the entire population.

The water decontaminator was granted patent No. 2,752,309. Its inventors assigned the patent rights to the United States of America as represented by the Atomic Energy Commission.

Supersonic Beds

➤ PNEUMATIC beds for the pilots of the future, who will zoom through space at supersonic speeds, may solve some of the problems of space medicine. The beds are called "G" cush-

ions, "G" being a symbol used in aviation medicine for the unit of force which is exerted on the aviator's body during acceleration in flying.

The pressurized cushions automatically inflate and deflate themselves according to the change in the apparent weight of the pilot resting on them. They can also be used to air-freight delicate instruments in rockets or high speed airplanes. The cushions are designed so that the pilot reclines on his back when taking off into the atmosphere at high rates of acceleration.

The cushions are the invention of Ray F. Griswold of Castle Shannon, Pa. who was awarded patent No. 2,751,610. He assigned the patent rights to the Hagan Corporation of Pittsburgh, Pa.

Antioxidant From Fruit

➤ AN EDIBLE product that keeps organic material, such as food, rubber and fuels from going bad, has been found in the fruit of the Osage orange. The fat-soluble substance that makes an effective antioxidant was obtained by John R. Clopton of Boulder, Colo., who won patent No. 2,752,314 for his discovery.

The natural antioxidant, the inventor says, is not distributed uniformly throughout the fruit but is concentrated in the fruit bulk. It can be extracted and combined with organic matter to keep the matter from spoiling. Mr. Clopton states that since the Osage orange tree grows extensively throughout the southern, midwestern and eastern United States and since its fruit has received little attention from an industrial standpoint, the cost of the fruit is low. It is edible, he says, but is not relished by man because it is tasteless and fibrous. He assigned one-half the patent rights to the Texas Research Foundation of Renner, Texas.

Heat Resistant "Cermet"

➤ ALLOYS that are proving they can beat the heat of the thermal barrier include a group known as "cermets," a combination of ceramics and metals. One such "cermet," capable of resisting temperatures higher than 1,000 degrees Centigrade, has received a patent awarded by the Government.

The alloy is a heat resistant titanium carbide. It has been developed for a wide number of uses including jet airplane parts, fluid guiding members in power plants, high temperature wear and erosion resistant parts, and hot shaping dies and tools.

The composite's inventors, Claus G. Goetzel of Yonkers and John B. Adamec of Floral Park, N.Y., foresee the replacement of metallic alloys like stainless steel by the use of their invention and other materials with ceramic-like properties.

The alloy contains about 40% to 80% by volume of titanium-base carbide and about 60% to 20% by volume of a ductile heat resistant matrix forming metal. The inventors were granted patent No. 2,752,656 and assigned the patent rights to the Sintercast Corporation of America, Yonkers, N.Y.

Penicillin in Feed

➤ PENICILLIN, the antibiotic credited with saving countless human lives, can now be put to work fattening up the nation's livestock. This is the claim of Dr. Walther H. Ott, Westfield, N. J., who received a patent for a growth-promoting feed employing the wonder drug.

Dr. Ott says that it is possible to achieve remarkable and unexpected acceleration in growth rate of animals, superior to that obtainable with a complete diet, by incorporating in the diet a relatively small amount of penicillin.

The growth-promoting effect of the penicillin is effective, Dr. Ott points out, whether the farmer is giving his livestock a nutritionally-adequate diet or a nutritionally-deficient diet. He suggests that the drug be incorporated directly in the feedstuff.

In tests with the penicillin supplement and vitamin B-12, Dr. Ott has been able to get a weight increase of 10% to 20% greater than without penicillin. He was granted patent No. 2,753,266 for his invention and assigned the patent rights to Merck & Co., Inc., of Rahway, N. J.

New Method For Mining

➤ A NEW METHOD for mining sulfur, lead, mercury, petroleum, and other solids and liquids found below the earth's surface has earned a Government patent. Its inventor is Robert V. Heinze, vice-president in charge of process development of the Submerged Combustion Company of America, Inc., Hammond, Ind.

The method uses a hot liquid such as water for melting the underground minerals. In operation, a mining liquid is heated, and together with the gaseous products of combustion, is passing into the subsurface regions to melt the sulfur. The melted sulfur is then removed with the help of the same gaseous products of combustion by freeing them from the hot water and mixing them with the molten mineral.

Mr. Heinze claims that by using his invention the cost of mining sulfur and other minerals is reduced substantially because the water used in the process does not have to be fresh water. Nor does the water have to be specially treated because there are no boiler tubes needed in the process. In addition, he says, it is possible to mine with greatly reduced quantities of compressed air. Finally, he points out, stationary boilers are eliminated and costs further cut.

The invention received patent No. 2,754,098 and Mr. Heinze of Whiting, Ind., assigned the patent rights to the Submerged Combustion Company of America, Inc.

Fire-Retardant Paint

➤ A FIRE-RETARDANT paint which may be used to protect an underlying flammable structure has been discovered by Austin O. Allen of East Orange, Thomas M. Murray of Morris Plains and Felix P. Liberti of Totowa, N.J. Standing up to both weather and washing, the fireproof paint has as one of its ingredients the oil of boleko nuts from Africa. The invention received patent No. 2,754,217 and the three inventors assigned the patent rights to the Vita-Var Corporation of Newark, N.J.

Wine Stabilizer

➤ WILLIAM A. WISEMAN of London, England, was granted patent No. 2,754,212, for a new method of stabilizing wines to keep harmless deposits from settling in the wine bottle. The wine is treated to reduce the potassium-salt content without reducing the acidity. He assigned the patent rights to W. & A. Gilby Ltd., of London.

Book Condensations

THE HISTORICAL BACKGROUND OF CHEMISTRY — Henry M. Leicester — *Wiley,* 260 p., illus., $6.00. Tracing the development of chemistry through the thoughts and ideas of chemists.

AN INTRODUCTION TO REACTOR PHYSICS — D. J. Littler and J. F. Raffle— For the United Kingdom Atomic Energy Authority, *McGraw-Hill,* 196 p., illus., $4.50. Based on a set of declassified lectures given by the authors at the Reactor School of the Atomic Energy Research Establishment, Harwell.

INVESTIGATION ON THE THEORY OF THE BROWNIAN MOVEMENT — Albert Einstein, edited with notes by R. Furth, translated by A. D. Cowper — *Dover,* 122 p., paper, $1.25. Five papers gathered from rare German periodicals.

THE LAWS OF NATURE — R. E. Peierls — *Scribner's,* 284 p., *illus.,* $4.50. Presenting the principles of modern physics in simple language and without assuming any previous knowledge of this field.

THE MATHEMATICS OF PHYSICS AND CHEMISTRY — Henry Margens and George Moseley Murphy — *Van Nostrand* 2d ed., 604 p., illus., $7.95. Forming a bridge between ordinary training in differential and integral calculus and the mathematical knowledge needed for advanced scientific developments.

NEUTRON CROSS SECTIONS — Donald J. Hughes and John A. Harvey — U. S. Atomic Energy Commission, *McGraw-Hill,* 328 p., illus., $12.00. Tables of thermal cross section values and of resonance parameters of a number of isotopes of each element and diagrams showing cross section curves and angular distributions as functions of energy.

ORGANIC CHEMISTRY — Louis F. Fieser and Mary Fieser — *Heath,* 3d ed., 1112 p., illus., $9.00. New edition of an established text. Also available in a trade edition from Reinhold at $10.00.

THE PHYSICAL WORLD — Paul McCorkle —*McGraw-Hill,* 2d ed., 465 p., illus., $5.25. Text for a survey and orientation course.

THE INTERNATIONAL DICTIONARY OF PHYSICS AND ELECTRONICS — Walter C Michels and others, Eds. — *Van Nostrand,* 1004 p., illus., $20.00. Prepared by an international group of scientists and educators, the dictionary is nevertheless in English only.

DEFECTS IN CRYSTALLINE SOLIDS — Report of the Conference on Defects in Crystalline Solids held at the H. H. Wills Physical Laboratory, University of Bristol — N. Bloembergen and others — *The Physical Society,* 429 p., illus., paper, $6.00. Describing defects, especially dislocations and point defects and new experimental methods of investigating their properties.

THE CHEMISTRY OF THE COORDINATION COMPOUNDS — John C. Brailer, Jr., Ed. and Daryle H. Busch, Ed. Asst. — *Reinhold,* 834 p., $18.50. Werner's coordination theory might be said, the author points out, to underlie our modern concepts of molecular structure.

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